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SVIC NOTES

KEEPING CURRENT

How current is the information found in books, articles, short courses and meetings? The answer is that the newest information is found at meetings and conferences, followed in descending order by the information found in short courses, articles and books. The only way to get more timely information is to make personal visits to organizations; we do this at SVIC on a regular basis. The best most of us can do to keep up with new developments is to attend annual meetings and conferences.

I prefer meetings where the proceedings are available the time of the meeting. This allows me to do a better job of selecting the papers I wish to hear. And, I can always read the papers I couldn't listen to because of conflicting schedules. The disadvantage of having the published proceedings available at the meeting is that the papers must be submitted eight to ten months prior to the meeting. This causes the information to be less timely and often causes the papers to be too brief. If you can't attend the meeting then buy the proceedings or read a meeting review in the DIGEST. Also, consult the Digest meetings calendar so you don't miss any important meetings.

One should not overlook the advantages of the personal contacts made at the meetings. It is important to be able to meet with the authors after the session in order for them to answer any questions you may have about their presentation. Authors will tell you things verbally that they would not put in a written paper.

Reading about meetings in the DIGEST isn't the same as being there. Attending meetings is a must to keep up with new developments.

J.G.S.

EDITORS RATTLE SPACE

TECHNOLOGY TRANSFER TODAY

The rate of technology transfer, which has increased dramatically during the last twenty years, is undoubtedly motivated by the demand for high technology and a cost conscious public. The public have been continually asking for more elaborate devices at reasonable prices. This demand has continued to stretch the talents of engineers who have to meet these demands at reasonable prices. Thus, engineering has to be cost effective and timely. This situation imposes the requirement that engineers do not reinvent the wheel; and, therefore use existing technology when available. Twenty years ago new technology was slow to move from the research labs to journals then to books and handbooks used by engineers. Today the technology transfer process has increased in activity and efficiency. Secondary journals like the **DIGEST** provide directed, ready access to pertinent new technology. Short courses direct the knowledge of technical experts on procedures, methods, and physical data to new engineers and those unfamiliar with the area.

The number of journals and journal articles which transfer technology from research and development areas have doubled during the past twenty years. In addition, the technology in these journals is utilized faster and more effectively due to technology transfer procedures and techniques. No longer is the engineer at the mercy of experts to go through the slow process of writing handbooks before it will be usable. Today information is readily identified by computer data bases like that being developed from the **DIGEST**. However, information must be distilled by the engineer who intends to use it rather than the handbook writer.

The number of short courses, another instant source of technology, have increased by at least an order of magnitude in the last ten years. Prior to this time engineers were at the mercy of colleges and universities to offer specialized courses. This could not be efficient nor cost effective because of the specialized nature of the technology and the applications. It was impossible for colleges and universities at local levels to provide this specialized information. Technology transfer groups like the Shock and Vibration Information Center grew as the need for this service grew. Today, as a result of national demand, all types of specialized courses -- as shown by the **DIGEST** monthly short course listings -- are available. These courses are usually performed on a national level, yielding the best teachers at a cost effective rate for the technology transfer. Often the ideas gained at such sessions yield results worth many times the cost of the course. This process tends to upgrade the technical capabilities of engineering staff, which elevates the general level of knowledge of all engineers and technicians.

The technology transfer process has developed rapidly during the past ten years to provide more knowledge to engineers at a faster rate. However, the distillation of the literature into handbooks and monographs has lagged the progress on information retrieval and short course performance. Up to now there is no magical, fast way to transform specialized technology from journals and reports into handbooks, tables, and computer data bases. The work is slow and unrewarding. The problem always arises on who will organize and pay for it. It is obvious that it requires joint efforts with the cost spread out over many companies. Today, no good means has been found to accomplish this process on a large scale basis. It is hoped that the next ten years will yield the same progress on literature distillation as the last era did on literature access.

R.L.E.

RECENT ADVANCES IN THE ANALYSIS OF EXHAUST MUFFLERS

M.L. Munjal*

Abstract. The article reviews recent advances in three major approaches to the analysis of exhaust mufflers: aeroacoustic, finite element, and finite wave. Contributions in the last four years are assessed in the context of earlier work as well as contemporary work. Emphasis is on application and usefulness in design of exhaust mufflers.

Exhaust noise of reciprocating internal combustion (I.C.) engines, which power most road vehicles, is the largest single component of urban noise pollution. Since publication of the last review article [1], substantial advances have been made in predicting and suppressing this noise. The present article reviews these recent developments. Some have also been reviewed elsewhere [2-4].

The exhaust system of an I.C. engine consists of exhaust valves or ports, exhaust manifold, exhaust pipe, muffler, and tail pipe. In the absence of a muffler, exhaust pipe and tail pipe are the same. The combination of exhaust pipe, muffler, and tail pipe is called the exhaust muffler. The portion of the exhaust system upstream of it is called the exhaust source. For acoustic studies the exhaust system can be divided into three parts: the source, the muffler, and the radiation impedance [1].

The three approaches to the analysis of exhaust system are the acoustic or aeroacoustic approach, the finite wave approach or method of characteristics, and the finite element approach. The first approach is the oldest; the finite wave approach was first used about 40 years ago. The finite element approach has been used for 20 years. The most significant advances in all of the approaches have taken place in the last 10 to 15 years. Developments during the last four years are reviewed in this article.

AEROACOUSTIC APPROACH

The acoustic approach is an extension of the acoustic theory for acoustic filters with stationary medium. It takes into account both convective and dissipative effects of mean flow on wave propagation through the muffler as well as acoustic radiation at the free end of the tail pipe.

Uniform Tube. A uniform tube or pipe is the most essential element in the exhaust system. Munjal [5] solved the convective one-dimensional wave equation and derived a transfer matrix for a uniform tube with respect to convective (or aeroacoustic) state variables p_c and v_c; these variables are linearly related to the classical acoustic state variables of pressure P and mass velocity v. The same transfer matrix was shown to hold for the acoustic state variables.

Recently To [6], working through velocity potential, has claimed that Trimmer's formulation [7] is more logical. However, Munjal and Thawani [8] have pointed out a mistake in Trimmer's formulation. The effects of mean flow have been argued and measured by means of the standing wave ratio method [9]. These measurements corroborated Munjal's predictions, in particular that mean flow does not alter the characteristic impedance of wave propagation.

Thus, Munjal's transfer matrix [5] is agreed to be the correct transfer matrix for a uniform tube with moving medium (plug flow). Prasad and Crocker [10] have

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developed a transfer matrix for a straight pipe with mean flow and a linear temperature gradient. They showed that, in the limiting case of uniform temperature, their transfer matrix reduces to that of Munjal. There is, however, no experimental verification of the theory.

Eriksson [11] recommends a specific approach -- analogous to that used in rectangular ducts -- for labeling the various higher order modes in a circular duct. This approach has geometric clarity and elegance in that for (m,n) mode, m becomes the order of the Bessel function and equals the number of pressure nodal diameters, in direct analogy with the rectangular duct case; n becomes equal to the pressure nodal circles.

The mean flow invariably has a transverse shear because of a boundary layer. The effects of this layer on wave propagation in a circular duct have been studied theoretically [12]. The results indicate that a boundary layer tends to increase the attenuation rate of all duct modes except the fundamental (o,o) mode moving upstream. Panicker and Munjal [13] have predicted pressure attenuation constants for wave propagation along or against turbulent mean flow in a uniform pipe.

There have been significant advances in the analysis of wave transmission through acoustically lined ducts; such ducts are rarely used in engine exhaust systems [14]. A computer program [15] predicts maximum exponential attenuation of a least naturally-attenuated mode in rectangular, annular, and cylindrical ducts with either uniform or sheared flow. These studies were necessitated by conditions prevailing in quieted high-bypass turbojet engine nacelles. Similar analytical techniques have been developed and experimentally verified [16]. Most papers on the subject, however, make use of numerical techniques; e.g., the finite difference method [17, 18] and the finite element method [19]. The latter is discussed in a later section of this article.

Sudden Area Changes. Aeroacoustics of area discontinuities continue to engage the attention of many researchers. Davies [20] has observed that synchronization of mean flow vortex motion with an incident acoustic field from a source upstream can enhance sound by transfer from mean flow; vortices, though not themselves strong radiators of sound, can strongly excite resonators. Detailed measurements in air of both pressure and velocity fields at the slot (mouth of the resonator) have been described and analyzed [21].

Eriksson [22] has discussed higher order mode propagation, tunneling, and leakage through an expansion chamber for various inlet and outlet locations as well as interactions with plane waves. His experiments indicate that an offset outlet location suppresses the effect of the first radial mode in an expansion chamber with an axially centered inlet and improves the insertion loss above the cutoff frequency for this mode. Offset inlet and outlet locations 180° apart caused decreased insertion loss compared to an axially symmetric expansion chamber; the reason was excitation and transmission of the first asymmetric mode. Expansion chambers with a centered inlet and offset outlet demonstrate plane-wave behavior to relatively high frequencies [22]. It is important to consider three-dimensional aspects of the design and to analyze symmetry that might emphasize specific higher order modes [23, 24].

Bostrom and Nilsson [25] investigated the transmission and reflection of sound in a cylindrical duct containing several discontinuities. They used a building block method and the Wiener-Hopf technique. Mean flow was not considered. The work is an extension of earlier work on propagation of sound in cylindrical ducts with mean flow and bulk-reacting lining [26-28].

Panicker and Munjal [29, 30] derived and verified transfer matrices for simple area changes, extended-tube elements, and flow-reversal tubular elements. They used steady flow equations to calculate mass continuity, momentum balance, adiabaticity, and drop in stagnation pressure; subtracted these values from corresponding perturbed equations; and linearized the resulting equations in terms of convective state variables. This approach implies an assumption that any possible pressure discontinuity across an abrupt area change is due to entropy variation [5] rather than existence of higher order acoustic modes [31].

Lung and Doige, however, made precise measurements by their time-averaging transient testing method and concluded that Munjal's model [5] was less accurate in predicting the peaks and minima of curves. They also concluded that the effects of higher order acoustic modes are significant to some extent, especially at higher frequencies [32]. In this connection, Lambert and Steinbrueck's investigations are significant. They used Kathuriya and Munjal's impedance tube method [34] in the upstream tube of a sudden expansion element and concluded that the Pollack end connection [35] or Karal discontinuity correction [34] is important and appears to be a valid representation of reactive acoustic fields at sufficiently low Mach numbers.

The phase of the reflection coefficient, which is dictated by the Karal correction, is thus highly frequency dependent but not significantly flow dependent. On the other hand, the modulus of the reflection coefficient is flow dependent (aeroacoustic losses consequent to drop in stagnation pressure across the discontinuity) but not significantly frequency dependent. It is clear that area discontinuity acts like an in-line lumped impedance [36], the resistive (or real) part of which is provided by a mean flow stagnation pressure drop and the inertive (or imaginary) part by an inductance effect of non-planar modes.

Perforated Elements. Analysis of the perforated elements used in most commercial mufflers began recently when Sullivan and Crocker [37] suggested an analytical approach to predict the transmission loss of concentric tube resonators. They solved the coupled equations by writing the acoustic field in the annular cylindrical cavity as an infinite summation of natural modes satisfying rigid-wall boundary conditions at the two ends. Their predictions were corroborated by experimental observations. This method could not be applied to other perforated elements, however.

Sullivan [38, 39] presented a segmentation procedure for modeling all types of perforated element mufflers. He described each segment by a separate transfer matrix. The number of segments into which a perforated tube is divided is arbitrary and must be sufficiently large. Sullivan's predictions tallied well with experimental findings.

Jayaraman and Yam [40] introduced a decoupling approach to obtain closed form solutions. A major drawback, however, is that decoupling was possible only for a hypothetical case -- that mean flow Mach numbers in communicating ducts are equal; this case is not valid. This approach has been verified for plug mufflers [41]. Thawani and Jayaraman [42] extended the approach to concentric tube resonator mufflers and limited their analysis to the case of zero mean flow.

Sullivan and Crocker's approach has been extended [37] to an analysis of a variable diameter, concentric, perforated tube cavity resonator [43]. Rao and Munjal [44] have recently developed a generalized decoupling method that does not suffer from the limitation of equal Mach numbers. It can be applied to all types of perforated elements; e.g., plug mufflers, concentric tube resonators, three-duct through flow mufflers, and three-duct reverse flow mufflers.

Transmission of internal sound through the walls of cylindrical shells was first studied by Cremer [45] and Heckl [46]. Higher mode transmission through the walls of circular pipes has recently been studied [47, 48]. Early work on the lowest mode acoustic transmission through the walls of rectangular ducts [49-51] has been extended to higher modes [52-54]. A multimode model has also been proposed in which transmission of more than one mode is tackled simultaneously in an approximate way [54]. For most practical purposes the lowest mode transmission is most important; design charts are available [51].

Radiation Condition. Johnston and Ogimoto [55, 56] have extended Levine and Schwinger's [57] analysis of acoustic radiation from the open end of a tail pipe with stationary medium to the case of moving medium. Unfortunately, they considered only the convective effect of mean flow. Munt [58] considered conversion of low frequency sound into hydrodynamic energy of vortices shed from a pipe edge. Because Munt's solution is complicated and must be evaluated numerically, asymptotic approximations for sound radiation with hot exhaust have been carried out by others [59, 60].

Howe [61] has argued that attenuation can be regarded as necessary to maintain corresponding large-scale coherent structures; he calculated the pressure reflection coefficient and far-field acoustic power as a fraction of transmitted power. Reflection coefficients have been measured [62]; they compared well with Munt's predictions [58].

Davies and Halliday [63] have shown experimentally that energy transferred from an acoustic field to potential disturbances in an issuing jet introduces a loss in radiated sound power level that never exceeds half a dB or so. This is opposite Howe's predictions; but there is large scatter in the experimental observations [63]. Panicker and Munjal [64] measured radiation impedance of an unflanged pipe with mean flow and derived empirical relations in terms of its non-flow value [57] and the mean flow Mach number. The effect of mean flow was to decrease radiation resistance.

Source Characteristics. Prediction of insertion loss is the most realistic criterion of the aeroacoustic performance of an exhaust muffler; such a prediction requires prior knowledge or measurement of the internal impedance of the exhaust source as a function of frequency. The other characteristic of the source required to predict noise radiated by an exhaust system corresponds to the open circuit voltage of an electrical source. Attempts have been made [65, 68] to measure the source impedance directly by exciting a running engine by a strong generator, making use of an impedance tube, and ignoring the engine exhaust noise. These attempts have been reasonably successful except at low frequency (of the order of the firing frequency), at which point engine exhaust noise is comparable to that of the external signal. Doige and Thawani [69] have also used the method.

Kathuriya and Munjal [70] have, on the other hand, proposed an indirect three-load method with or without impedance tube; the method would simultaneously yield both source characteristics at all frequencies. The method has yet to be proved in practice although preliminary results have been encouraging. Temple [71] has also investigated the source characteristics of engine exhaust systems. Gas dynamical equations of flow through cylinder-valve-manifold junctions have been written for interactions of a multi-cylinder compressor discharge system [72].

Aeroacoustic Measurements. In-pipe measurements are needed to determine the reflection coefficient and impedance of a passive termination; a passive termination can be the atmospheric termination, one or more acoustic elements, or a relatively weaker source. These measurements are meant either to verify a prediction method or to provide basic data for the development of one. The many methods available for acoustic impedance measurement have been reviewed recently [73]. The popular or useful of these methods are:

Standing wave tube method (standard) [74-76] with different modifications necessitated primarily by the moving medium in exhaust systems [34, 68, 77, 78]

Impulse method [79-81]

Constant volume velocity method [82-84]

Three pressure method [34, 70, 78, 85]

Two-microphone (adjacent-cross spectral density) method [66, 76, 86-90]

Four-pole coefficients measurement method [32, 91-93]

The time-averaging transient testing method of Lung and Doige [32] requires special data-processing instruments but seems to be the most accurate and reliable of the methods based on digital instrumentation. Keefe and Benade [94] have discussed source and microphone proximity effects in impedance measurement. Walker and Charwat [95] have investigated the correlation of the effects of grazing flow on the impedance of an isolated Helmholtz resonator. Roland [96] has indicated the errors that can be committed in a recent draft proposal of the International Standards Organization on measurement procedures for ducted silencers. Ramakrishnan [97] has given a brief summary of a theoretical analysis to decompose a measured pressure signal into its modal components.

Overall Performance Evaluation. Miles [98] has presented a method for constructing the acoustic transfer matrix of a variable area duct or nozzle carrying compressible subsonic flow. He used successive multiplication of the transfer matrices of various constituent regions into which the duct is arbitrarily divided. Mean flow Mach number is assumed to be constant in each region, and area variation is approximated by an exponential area variation.

Munjal [99] has formally shown that a reactive muffler creates an impedance mismatch at the source by reducing the resistive component of the acoustic impedance. This mismatch assures that much less power enters the muffler and hence much less power is created than without the muffler. A reactive muffler thus controls noise at the source and not in the path, unlike a dissipative muffler [99].

In one investigation on mufflers the source impedance effect was neglected [100]. Thawani and Noreen [101] have developed a computer-aided analysis of exhaust mufflers. Sneckenberger [102] has also reported a computer-aided approach for predicting performance of engine exhaust muffler. Studies on insertion loss of a multi-cylinder engine exhaust muffler have been reported [67]; measured values of source impedance were used and indirectly verified.

Methods developed for the analysis of exhaust mufflers of I.C. engines have been used successfully on compressor discharge systems [72] and to predict pressure pulsations in pipeline networks used in the oil and gas industry [103, 104].

FINITE-ELEMENT APPROACH

For a number of large or complex acoustic elements three-dimensional effects play a significant role, especially at area discontinuities and pipe junctions. The aeroacoustic approach is adequate if plane waves are the only ones that exist. The finite-element approach, although comparatively much more laborious, can be applied to all geometries at all frequencies. The larger the frequency, the greater must be the number of elements per unit volume.

The first complete formulation that included both acoustic and structural vibration problems was presented by Gladwell [105]; he used the energy formulations of Gladwell and Zimmermann [106] and laid the foundation [107] for the finite element method [FEM]. Young and Crocker [108] derived the variational formulation of a theoretical model for an acoustic system in a general form similar to that described by Gladwell [105] and applied their finite element method to wave transmission in flow-reversing muffler chambers [109]. They employed idealizing methods so that only rectangular elements were used; the two dimensional program was applicable only if the third dimension of the muffler was smaller than the other two dimensions. This is the case when a reversing chamber has an elliptical shape. Mean flow effects were not considered in the theory.

Craggs [110] developed an FEM for determining the natural modes and frequencies of complex shaped enclosures; Joppa and Fyfe [111] developed one for impedance properties. Young and Crocker [112] extended their FEM to take into account the effect of wall vibrations on internal wave propagation. Craggs investigated expansion chamber mufflers with multiple input and output configurations and reactive boundaries [113] and then extended his work to dissipative boundaries [114]. The effects of sound absorbing walls and temperature gradients have also been incorporated [115]. Ross introduced a technique for analyzing systems that include parallel coupled systems as a series of subsystems [116]. This technique is versatile and economic with regard to computing costs.

A combination of FEM and an analytical approach (Green's Theorem) has been presented for modeling the radiation condition [117]; the combination was also applied to conical and exponential horns. Lagrangian elements (potentials and their first space derivatives) have been used at nodes for the eigenvalue problem in lined ducts with flow [118]; accuracy of results was improved by replacing the Lagrangian elements with Hermitian elements, in which modal variables also include nodal derivatives [119]. Up to 1978 all finite element formulations were for a stationary medium. The method of weighted residuals [120] and the finite element method [121, 122] for acoustic transmission in nonuniform ducts have been extended to the case of a moving medium [123, 124]. A unique feature of the weighted residual approach is the use of basis functions generated from eigenvalue calculations when there is no flow [123]. The basic method [121] was modified by a crude wave envelope approach; a significant increase in accuracy was obtained through considerable reduction in estimated dimensionalities involved in applying such techniques to realistic aeroacoustic configurations where high frequency modes propagate [125].

Ross [126] has developed FEM for perforated component acoustic systems; he incorporated an adjoint system concept which gains energy as rapidly as the real system loses it [105, 113, 116]. Perforate flow effects were included; convective effects were neglected. Peat [127] has extended Young and Crocker's work on four-pole parameters [108, 109] to include mean flow effects. Craggs [105, 108, 110] has presented a simplification of the conventional three-dimensional element FEM for a simple pipe acoustic element the transverse dimensions of which are small compared to wavelength [128].

In one new approach [129] a conventional FE solution on the inner region is compatibly matched to a wave envelope FE solution in a large but finite outer region. Acoustical radiation in the near field is thus modeled; the Sommerfeld radiation condition is then applied in the usual way at a distant but finite boundary to determine the far-field radiation pattern [129]. Unfortunately, only stationary media have been considered.

A new method, the boundary element method, [130] has recently been applied to one-dimensional acoustic elements [131]. This method is preferred to FEM because it involves less computer time and storage and does not call for refined element meshes at higher frequencies. However, the boundary element method is dependent upon the existence of a general solution to the governing equation. The method has been demonstrated for uniform pipe elements and conical elements; both are governed by the horn equation for stationary medium [131].

FINITE WAVE APPROACH

Unlike aeroacoustic analysis, in which periodic acoustic perturbations on mean values are involved, finite wave equations are solved numerically in the time domain. The basic equations need not be linearized; hence the name finite wave analysis. Although unsteady flow effects and finite amplitude waves have been studied for more than a century, their application to engine exhaust systems began only in 1942 [132]. The graphical calculation technique was consolidated by Rudinger in the form of wave diagrams [133]. A breakthrough came in 1964 with a comprehensive numerical technique, the so-called mesh method, that was especially suited to digital computation [134]. This technique was extended to multi-cylinder diesel engines [135, 136] and to small engines of the automotive type, principally those used in power motorcycles [137-139]. Eventually a computer-aided design for both performance characteristics and noise levels was developed [140]. Other work along similar lines had also been going on [141-143].

Jones and Brown [144] recently reported development of an alternative computational technique for the method of characteristics solution of one-dimensional flow. They used Whitham's characteristic form of basic equations [145]. Actual wave diagrams (characteristics) are calculated by this method. It is considerably more tedious than the mesh method [146].

Most of the investigations in this field have been limited to exhaust systems consisting of only an exhaust pipe. When mufflers have been included, either the analysis has been limited to simple area changes or entropy variations have been ignored [137-139, 144]. However, a comprehensive computer program has been developed that accounts for entropy and temperature variations at area discontinuities, pipe junctions, and valves/ports; an entropy characteristic in addition to the usual two wave characteristics is used. The program can handle all tabular muffler components including simple area changes, extended inlet and outlet, reverse-flow contraction, and expansion elements [147]. The program has also been used to predict noise radiation and to indirectly evaluate both aeroacoustic source characteristics from Fourier components of predicted mass flux and pressure time histories at the exhaust valve [147, 148].

CONCLUDING REMARKS

The ɾoacoustic approach, though generally limited to plane wave propagation, is best applied to engine exhaust systems in which higher mode effects are not significant except for a few configurations. The finite element approach takes into account three-dimensional effects and therefore can be applied to any geometry. However, it has not yet been developed to the extent that it can be applied with as much ease and convenience as aeroacoustic approach. The finite wave approach not only takes into account nonlinear wave effects but also provides time histories of state variables that are useful for optimizing the thermodynamic performance of engines. However, only one-dimensional unsteady flow can usually be considered. Thus all of the approaches must be mastered if a given exhaust system is to be precisely analyzed or a system is to be designed for optimum thermodynamic and acoustic performance.

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LITERATURE REVIEW: survey and analysis of the Shock and Vibration literature

The monthly Literature Review, a subjective critique and summary of the literature, consists of two to four reviews each month, 3,000 to 4,000 words in length. The purpose of this section is to present a "digest" of literature over a period of three years. Planned by the Technical Editor, this section provides the **DIGEST** reader with up-to-date insights into current technology in more than 150 topic areas. Review articles include technical information from articles, reports, and unpublished proceedings. Each article also contains a minor tutorial of the technical area under discussion, a survey and evaluation of the new literature, and recommendations. Review articles are written by experts in the shock and vibration field.

VIBRATION PROBLEMS IN JET ENGINES

M. Lalanne*

Abstract. This paper reviews the articles published since 1979 on vibrations in jet engines: blades, disc and blades, rotors.

This paper follows the one published in 1980 [34]. Other papers dealing with parts of this subject have been presented recently [36, 53, 54, 63]. At present, it is necessary to know the dynamic behavior of rotating machinery components and specifically of jet engine components with increased accuracy. Since 1979 the research work performed has been oriented towards two main directions. Work has been done on the prediction of natural frequencies and mode shapes of blades and disc-blades, on critical speeds, and unbalance response of rotors. Other work is now oriented towards the definition of more realistic prediction, i.e., knowledge of aerodynamic and friction damping, estimation of excitation forces and inclusion of nonlinearities in the models.

This presentation has not considered the flutter effect and is composed of three main parts: blades, disc and blades, and rotors.

In [5] Bellamy, et al, have presented the prediction of the behavior of a complete Rolls-Royce carcass and nacelle. Vibration problems in JT15D and PT6 installations have been shown by Botman [6]. Klompas has given a method for predicting the unbalance response of a turbomachine including effects such as mount asymmetry, anisotropy in fluid film bearings, disc flexibility [32]. Childs has reviewed the problems encountered in studying the dynamics of the rotors of the high pressure oxygen turbopump of the space shuttle main engine [8].

BLADES

In [1] the area of free vibrations, hollow blades which convey fluids have been studied. The influence of shear, rotatory inertia and Coriolis forces on the free and forced vibrations of turbine blades has been discussed in [4]. Sisto, et al, have considered the influence of Coriolis forces and shown the possibility of unstable phenomena [59]. The effect of blade discretization on the prediction of resonant stresses has been presented in [57]. Leissa and Ewing have compared for thin blades the free vibrations using beam and shell theory [37]. Lee, et al, have predicted the free vibration of blades by a shell theory [35]. In [21] Gudmundson presents a perturbation method for a turbine blade to calculate changes in frequencies due to changes in geometry. Queau and Trompette have shown a general optimization method for minimizing the mass of rotating turbine blades [52]. In [44] Naess and Teien present analytical and test methods used to investigate a failure problem. Owczarek uses the wave reflection theory to explain axial compressor blade vibrations [46]. Analytical and experimental results on dry friction damping are presented by Srinivasan and Cutts in [61]. Sinha and Griffin study [60] the effect of platform friction. Measurement and analysis of platform damping are shown in [33]. Muszynska, et al, study the nonlinear response of multiblade systems [42]. A discrete model of a multiblade system with interblade slip is also shown in [31]. Srinivasan and Cutts have given experimental results on motions at shroud interfaces [62] and measured the response of a part span shrouded fan to aerodynamic excitation [64]. Sheng and Mosiman have analyzed the influence of friction on the resonant stresses in turbine blade [56]. Srinivasan, et al, [60] have discussed blade damping in jet engines:

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platform dampers, slipping at roots and rubbing at shrouds. The effect of root flexibility on shrouded blades using a perturbation technique has been shown in [40]. Griffin and Sinha have investigated the effect of mistuning on blade to blade frictions damper and the importance of friction slip force for shrouded fan blades [19].

DISC AND BLADES

Crawley has presented measurements of aerodynamic damping in transonic compressors [9]. He has experimented and calculated blade disc inertial coupling [10] with high mistuning. Crawley and Mokadam [11] have experimented and calculated blade-disc elastic coupling. Muszynska and Jones have shown on simple discrete model of blade-disc taking into account friction and structural damping, mistuning, and several types of excitation [43]. Wildheim has calculated the natural frequencies of rotating blade disc using clamped-free modes [68]. Ewins and Imregun have, via a receptance substructuring method, predicted the natural frequencies of a disc with packeted blades [14]. In [13] Ewins and Han have investigated the response level of mistuned bladed disc. Irretier has studied the frequency splitting and shifting of a mistuned bladed disc via a component mode method [29]. Griffin and Moosac have presented a statistical assessment of the influence of mistuning on the resonant response of a bladed-disc assembly [20]. Jay, et al, have presented experimental and analytical results on the response of a disc blade assembly due to excitation caused by an upstream stator row [30]. Stange and MacBain have investigated the dual mode phenomena in mistuned bladed discs [66]. The maximum resonance response of a mistuned bladed disc having closely dual modes is presented in [41]. Ferraris, et al, have presented results on predictions of frequencies and mode shapes of jet engine bladed rotating axisymmetric structures [15, 16]. The behavior of impellers has been predicted, using Aska, and experimented by Wachter and Celikbudak [67]. Elchuri, et al, have used Nastran for obtaining natural frequencies and response of rotating cyclic structures [12]. Henry has presented a method based on substructures and wave propagation theory for predicting natural frequencies of cyclic structures [25, 26]. Henry and Ferraris have also analyzed experimentally and theoretically an impeller [27].

ROTORS

In [17] Glasgow and Nelson have studied the stability of a dual rotor with damped and undamped isotropic bearings via a component mode synthesis. A Guyan reduction technique has been used to significantly reduce the number of degrees of freedom [55]. Li and Gunter have used a component mode synthesis for investigating the behavior of large rotor systems; it has been applied to a two-spool aircraft gas turbine engine and to the space shuttle main engine liquid oxygen turbopump [38]. In [39] they have studied the modal truncation error. Nelson, et al, have also used a component mode synthesis for nonlinear analysis of rotors [45]. Palazzolo, et al, have, using the receptance approach, presented the component synthesis of multicase rotating machinery trains [50] and the eigensolution reanalysis of rotors [49]. Palladino and Rossetos have estimated the influence of the flexibility of the disc for several rotor configurations [48]. The behavior of rotor-bearing systems under stochastic loading conditions has been predicted by Hashish and Sankar [24]. In [7] Boyce, et al, give a probabilistic point of view of the determination of foundation forces and of their influence on the behavior of rotors. Gu Jia-Liu and Ren Pin-Zhen have given explanations for nonsynchronous whirls of the turbine rotors in jet engine [22]. For a two spool gas turbine engine with squeeze film bearings Gunter, et al, have investigated critical speeds, steady state and transient responses [23]. Stallone, et al, have studied the steady state motion due to blade loss [65]. Alam and Nelson have predicted a blade loss response spectrum for a dual shaft system [3]. Engine dynamic analysis with general nonlinear finite element codes has been performed by Adams, et al [2] and Padovan, et al [47]. Greenhill and Nelson [18] and Holmes [28] have worked on the use of squeeze film dampers for controlling rotor vibrations. Peduzzi has designed and built a test rig for simulating a dual rotor behavior [51.

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BOOK REVIEWS

FINITE ELEMENT PROGRAMS FOR AXISYMMETRIC PROBLEMS IN ENGINEERING

C.T.F. Ross
Halsted Press, Div. of John Wiley & Sons
New York, NY, 1984, 295 pages

This curious book is exactly what it's title says it is: a book on finite element programs for axisymmetric problems in engineering. Thirteen computer programs in CBM BASIC are presented, together with descriptions of how to use them. The book also contains a brief chapter on each of the 13 areas of application; e.g., thick and thin walled cylinders, cones, domes, plates, vibration, elastic stability, and thin walled shells. A section on theory consisting of a listing of key formulas is followed by a few numerical examples; program listings are given for each specific area of application in the Appendices. The book is a modern-day handbook; the only disappointing feature is that the reader is expected to transcribe the computer codes listed in the Appendix to his personal floppy disk. A large body of engineers equipped only with inexpensive microcomputers will possibly find this book useful.

The author notes in his Preface that the software given in the book is also offered in the form of convenient disks, which, one assumes, can be purchased from the author. He also says that, "It is most likely that in the near future programs such as these will become commonplace in classrooms, laboratories, design offices, etc." I suspect there is a great deal of truth in that statement. Although they are simple, BASIC programs such as these have a somewhat limited range of applicability. They nonetheless could prove useful from time to time in an engineering office. At the very least they provide examples from which those interested in developing their own software could begin a study of the subject.

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"ELASTIC PLASTIC FRACTURE," SECOND SYMPOSIUM VOLUME I: INELASTIC CRACK ANALYSIS

C.F. Shih and J.P. Gudas, Eds.
ASTM Special Technical Publication 803
1983, $80.00

This book contains half of the papers presented at the Second International Symposium on Elastic-Plastic Fracture Mechanics, which was held in Philadelphia during October, 1981. The book is divided into three areas of technical subject matter: elastic plastic crack analysis, fully plastic crack and surface flaw analysis, and viscoplastic analysis and correlation.

The 13 papers concerned with elastic plastic crack analysis are intended to treat the influence of elastic strains plus plastic flow on the state of stress at the tip of the crack. The papers include:

Dynamic Growth of an Antiplane Shear Crack in a Rate-Sensitive Elastic-Plastic Material, L.B. Freund and A.S. Douglas

Elastic Field Surround a Rapidly Tearing Crack, A.S. Kobayashi and O.S. Lee

Elastic-Plastic Steady Crack Growth in Plane Stress, A.H. Dean

A Finite-Element Study of the Asymptotic Near-Tip Fields for Mode I Plane-Strain Cracks Growing Stably in Elastic-Ideally Plastic Solids, T.L. Sham

Crack-Tip Stress and Deformation Fields in a Solid with a Vertex on Its Yield Surface, A. Needleman and V. Tvergaard

The J_{ext}-Integral Based on the Concept of Effective Energy Release Rate, H. Miyamoto, K. Kageyama, M. Kikuchi, and K. Machida

A Criterion Based on Crack-Tip Energy Dissipation in Plane-Strain Crack Growth under Large-Scale Yielding, M. Saka, T. Shoji, H. Takahashi, and H. Abe

Discontinuous Extension of Fracture in Elastic-Plastic Deformation Field, M.P. Wnuk

Influence of Compressibility on the Elastic-Plastic Field of a Growing Peak, Y.-C. Gao

Material Resistance and Instability Beyond J-Controlled Crack Growth, H.A. Ernst

An Elastoplastic Finite-Element Investigation of Crack Initiation under Mixed-Mode Static and Dynamic Loading, J. Ahmad, C.R. Barnes, and M.F. Kanninen

Elastic-Plastic Analysis of a Nozzle Corner Crack by the Finite-Element Method, W. Brocks, H.H. Erbe, H.D. Noack, and H. Veith

Elastic-Plastic Finite-Element Analysis for Two-Dimensional Crack Problems, P.D. Hilton and L.N. Gifford

The papers by Sham, Needleman, Gao, Ahmad, Brocks, Hilton, Saka, and Kobayashi present extensive elasto-plastic field solutions for the state of stress around cracks. The papers by Ernst, Freund, Wnuk, and Dean deal with elasto-plastic crack growth subject to specialized conditions. Miyamoto's paper deals with fundamental J_{ext}-integral concepts. Overall the group of papers appear to be well organized and written and confined remarkably to the topic area.

Eleven papers deal with crack propagation in fully plastic structural elements. Problems of elastic-plastic line-spring models, surface flaws, and surface flaw crack growth are included:

Bounds for Fully Plastic Crack Problems for Infinite Bodies, M.Y. He and J.W. Hutchinson

Penny-Shaped Crack in a Round Bar of Power-Law Hardening Material, M.Y. He and J.W. Hutchinson

Elastic-Plastic and Fully Plastic Analysis of Crack Initiation, Stable Growth, and Instability in Flawed Cylinders, V. Kumar, M.D. German, and C.F. Shih

A Superposition Method for Nonlinear Crack Problems, G. Yagawa and T. Aizawa

Consistency Checks for Power-Law Calibration Function, D.M. Parks, V. Kumar, and C.F. Shih

Ductile Growth of Part-Through Surface Cracks: Experiment and Analysis, C.S. White, R.O. Ritchie, and D.M. Parks

Evaluation of J-Integral for Surface Cracks, M. Shiratori and T. Miyoshi

Effects of Thickness on J-Integral in Structures, M. Sakata, S. Aoki, K. Kishimoto, M. Kanzawa, and N. Ogure

J-Integral Analysis of Surface Cracks in Pipeline Steel Plates, R.B. King, Y.-W. Cheng, D.T. Read, and H.I. McHenry

Use of J-Integral Estimation Techniques to Determine Critical Fracture Toughness in Ductile Steels, G. Green and L. Miles

Evaluation of Plate Specimens Containing Surface Flaws Using J-Integral Methods, W.G. Reuter, D.T. Chung, and C.R. Eiholzer

In the two He and Hutchinson papers energy methods are used to bound the J-integral. The Kumar and Sakata papers deal with flaws in rotationally symmetric problems. Surface flaws in plate material are treated by Reuter, King, Shiratori, and White. Fundamental experimental concepts are treated by Sakata. Fundamental questions of criteria are discussed by Yugawa and Parks. Both authors attempt to explain anomalies that have arisen in finite element solutions for nonlinear and power law modeled problems.

The third group of 13 papers deals with the problems of viscoplastic analysis and correlation. The problems involve crack growth at elevated temperatures and include creeping cracks, micro-structural modeling, creep crack growth correlations, and materials correlations. This group consists of the following papers:

Crack-Tip Stress Fields and Crack Growth under Creep-Fatigue Conditions, H. Riedel

Stable Crack Extension Rates in Ductile Materials: Characterization by a Local Stress-Intensity Factor, E.W. Hart

Cracks in Materials with Hyperbolic-Sine-Law Creep Behavior, J.L. Bassani

Stress Concentrations due to Sliding Grain Boundaries in Creeping Alloys, G.W. Lau, A.S. Argon, F.A. McClintock

Steady-State Crack Growth in Elastic-Power-Law Creeping Materials, C.Y. Hui

Effects of Creep Recovery and Hardening on the Stress and Strain-Rate Fields near a Crack Tip in Creeping Materials, S. Kubo

On the Time and Loading Rate Dependence of Crack-Tip Fields at Room Temperature — A Viscoplastic Analysis of Tensile Small-Scale Yielding, M.M. Little, E. Krempl, and C.F. Shih

Boundary-Element Analysis of Stresses in a Creeping Plate with a Crack, V. Banthia and S. Mukherjee

Estimates of the C* Parameter for Crack Growth in Creeping Materials, D.J. Smith and G.A. Webster

Crack Growth in Creeping Solids, V.M. Radhakrishnan and A.J. McEvily

Parametric Analysis of Creep Crack Growth in Austenitic Stainless Steel, K. Sadananda and P. Shahinian

Microstructural and Environmental Effects during Creep Crack Growth in a Superalloy, S. Floreen

Influence of Time-Dependent Plasticity on Elastic-Plastic Fracture Toughness, T. Ingham and E. Morland

The Reidel, Ingham, Hui, Kubo, Radhakrishnan, and Hart papers deal with fundamental theory. The Bassani, Banthia, Smith, and Sadananda papers have to do with more specialized aspects; e.g., specialized analytical models for fracture analysis under plasticity and creep conditions. The Lau and Floreen papers are concerned with fundamental physics and metallurgical aspects of viscoplastic fracture. Little deals with some practical aspects of measurement of viscoplastic fracture parameters.

This book together with Volume II should be included in the library of any serious investigator of fracture analysis. It has been very well organized by the editorial team of Shih and Gudan. ASTM also deserves congratulations for their efforts in organizing the conference and publishing the book. (They are even to be forgiven for the erroneous section heading which appears as "Fully Elastic Crack, etc." when what is meant is "Fully Plastic Crack, etc. . .".)

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"ELASTIC PLASTIC FRACTURE," SECOND SYMPOSIUM VOLUME II: FRACTURE RESISTANCE CURVES AND ENGINEERING APPLICATIONS

C.F. Shih and J.P. Gudas, Eds.
ASTM Special Technical Publication 803
1983, $80.00

This book contains half of the papers presented at the Second International Symposium on Elastic-Plastic Fracture Mechanics, which was held in Philadelphia during

October, 1981. The book is divided into three areas of technical subject matter: engineering applications, test methods and geometry effects, and cyclic plasticity effects and material characterization.

Engineering applications consists of 16 papers that include a variety of difficult-to-deal with areas; e.g., tearing instability, J-based design curves, an overview of several fracture criteria, latest developments in fracture analysis diagrams, and analyses of flawed pipes. The papers include:

A Method of Application of Elastic-Plastic Fracture Mechanics to Nuclear Vessel Analysis, P.C. Paris and R.E. Johnson

Evaluation of the Elastic-Plastic Fracture Mechanics Methodology on the Basis of Large-Scale Specimens, K. Kussmaul and L. Issler

Studies of Different Criteria for Crack Growth Instability in Ductile Materials, S. Kaiser and J. Carlsson

Further Developments of a J-Based Design Curve and Its Relationship to Other Procedures, C.E. Turner

Application of Two Approximate Methods for Ductile Failure Assessment, L. Hodulak and J.G. Blauel

Development of a Plastic Fracture Methodology for Nuclear Systems, T.U. Marston, R.L. Jones, M.F. Kanninen, and D.F. Mowbray

Some Salient Features of the Tearing Instability Theory, H.A. Ernst

Verification of a Tearing Modulus Methodology for Application to Reactor Pressure Vessels with Low Upper-Shelf Fracture Toughness, S.S. Tang, P.C. Riccardella, and R. Huet

Ductile Tearing Instability Analysis: A Comparison of Available Techniques, G.G. Chell and I. Milne

Validation of a Deformation Plasticity Failure Assessment Diagram Approach to Flaw Evaluation, J.M. Bloom

Studies on the Failure Assessment Diagram Using the Estimation Method and J-Controlled Crack Growth Approach, C.F. Shih, V. Kumar, and M.D. German

Lower-Bound Solutions and Their Application to the Collapse Load of a Cracked Member under Axial Force and Bending Moment, H. Okamura, K. Kageyama, and Y. Takahata

Ductile Crack Growth Analysis within the Ductile-Brittle Transition Regime: Predicting the Permissible Extent of Ductile Crack Growth, I. Milne and D.A. Curry

Ductile Fracture of Circumferentially Cracked Pipes Subjected to Bending Loads, A. Zahoor and M.F. Kanninen

Engineering Methods for the Assessment of Ductile Fracture Margin in Nuclear Powet Plant Piping, S. Ranganath and H.S. Mehta

Fracture of Circumferentially Cracked type 304 Stainless Steel Pipes under Dynamic Loading, G.M. Wilkowski, J. Ahmad, Z. Zahoor, C.W. Marshall, D. Broek, I.S. Abou-Sayed, and M.F. Kanninen

The paper by Paris presents an excellent, well written overview of pressure vessel design using both EFM and EPFM. The Kussamaul and Kaiser papers contain European viewpoints and some criteria for crack growth instability. Turner reviews J-Integral design curves and their relationship to other procedures. Hodulak examines large-scale test specimens; Marston looks at ductile fracture methodology for nuclear systems. Ernst, Tang, and Chell discuss tearing instability facets of fracture. The papers by Bloom, Okamura, Milne, and Shih deal with fundamental aspects. The papers by Zahoor, Ranganath, and Wilkowski deal with cracked piping problems.

The second set of 14 papers deal with test methods and geometry effects. These papers focus on J_{Ic} and J_I-R test methods and computational procedures; several are devoted to the geometry of test specimens and its relationship to the J-Integral parameters. The papers include:

J_R-Curve Testing of Large Compact Specimens, D.E. McCabe and J.D. Landes

On the Unloading Compliance Method of Deriving Single-Specimen R-Curves in Three-Point Bending, A.A. Willoughby and S.J. Garwood

Evaluation of Several J_{Ic} Testing Procedures Recommended in Japan, K. Ohji, A. Otsuka, and H. Kobayashi

Evaluation of Blunting Line and Elastic-Plastic Fracture Toughness, H. Kobayashi, H. Nakamura, and H. Nakazawa

Instability Testing of Compact and Pipe Specimens Utilizing a Test System Made Compliant by Computer Control, J.A. Joyce

Computer-Controlled Single-Specimen J-Test, W.A. Van Der Sluys and R.J. Futato

Quantitative Fractographic Definition and Detection of Fracture Initiation in COD/-K_{Ic} Test Specimens, S.M. El-Soudani and J.F. Knott

Combined Elastic-Plastic and Acoustic Emission Methods for the Evaluation of Tearing and Cleavage Crack Extension, M.A. Khan, T. Shoji, H. Takahashi, and H. Niitsuma

An Analysis of Elastic-Plastic Fracture Toughness Behavior for J_{Ic} Measurement in the Transition Region, T. Iwadate, Y. Tanaka, S.-I. Ono, and J. Watanabe

An Evaluation of the J_R-Curve Method for Fracture Toughness Characterization, D.E. McCabe, J.D. Landes, and H.A. Ernst

Specimen Geometry and Extended Crack Growth Effects on J_I-R Curve Characteristics for HY-130 and ASTM A533B Steels, D.A. Davis, M.G. Vassilaros, and J.P. Gudas

An Elastic-Plastic Fracture Mechanics Study of Crack Initiation in 316 Stainless Steel, P.H. Davies

Thickness Effects on the Choice of Fracture Criteria, H.-W. Liu, W.-L. Hu, and A.S. Kuo

Experimental Validation of Resistance Curve Analysis, I. Milne

McCabe's paper describes special testing techniques for J_R-curve determinations. Willoughby discusses a specialized way of deriving R-curves. Ohji and Kobayashi describe aspects of J_{Ic} testing that are currently under consideration by the Japan Society of Mechanical Engineers. Joyce and Van Der Sloys deal with improved J-test methods that employ computer-controlled specimens. El-Soudani examines the use of microscopy to define and detect fracture initiation; Kahn examines combined acoustic emission techniques and J_{Ic} testing. Iwadate describes the influence of a variety of parameters on elasto-plastic fracturing behavior. McCabe and David deal with aspects of various test criteria using compact specimens. Davies is concerned with crack initiation phenomena in 316 stainless steel; Liu describes the effect of thickness on fracture criteria. Milne discusses some fundamental aspects of R-curve analyses (including C.E.G.B.). A variety of fundamental aspects of elastic-plastic fracture parameter tests are treated, and many fresh viewpoints are expressed in these papers.

The final seven papers are concerned with cyclic plasticity effects and material characterization. The stated purpose was to examine prior load history effects, crack growth in elastic-plastic regime under cyclic loading, and micromechanics studies of the fracture process. The papers are:

Elastic-Plastic Fracture Mechanics Analysis of Fatigue Crack Growth, M.H. El Haddad and B. Mukherjee

Elastic-Plastic Crack Propagation under High Cyclic Stresses, K. Tanaka, T. Hoshide, and M. Nakata

Load History Effects on the J_R-Curve, J.D. Landes and D.E. McCabe

Micromechanisms of Ductile Stable Crack Growth in Nuclear Pressure Vessel Steels, W.P.A. Belcher and S.G. Druce

Ductile Fracture with Serrations in AISI 310S Stainless Steel at Liquid Helium Temperature, R.L. Tobler

J-R Curve Characterization of Irradiated Low-Shelf Nuclear Vessel Steels, F.J. Loss, B.H. Menke, A.L. Hiser, and H.E. Watson

Initiation of Fatigue Cracks around Inclusions in Rolling Fatigue, M. Freitas and D. Francois

El Haddad, Tanaka and Landes deal with plastic aspects of fatigue crack extension. El Haddad's work in particular represents carefully controlled experiments; such data are needed. Tanaka's paper is fundamental. Belcher and Loss deal with the specialized behavior of nuclear steel plastic crack propagation. Freitas' paper is fundamental even though it deals with the specialized topic of railroad wheel plastic fatigue and fracture. Tobler addresses himself to the cryogenic fracture problem with elastic plastic flow.

This volume is superb; together with the first volume of the set it constitutes a library of information on this special topic. The two volumes are an absolute necessity for the serious student of fracture phenomena. Fracture analysts will also find the two volumes useful.

K.E. Hofer
L.E. Broutman and Assoc. Ltd.
Technology Center
3424 S. State Street
Chicago, IL 60616

SHORT COURSES

APRIL

MACHINERY RISK MANAGEMENT

Dates: April 15-17, 1985
Place: Carson City, Nevada
Objective: This course is a sequel to a risk seminar presented two years ago in Carson City, Nevada. It is designed to update insurance/risk managers on recent developments in predictive maintenance and diagnostic programs for rotating machinery.

Contact: Customer Information Center, Bently Nevada Corporation, P. O. Box 157, Minden, NV 89423 - (702) 782-3611, Ext. 9243.

MACHINERY INSTRUMENTATION

Dates: April 16-18, 1985
Place: Philadelphia, Pennsylvania
Dates: May 14-16, 1985
Place: San Francisco, California
Dates: June 25-27, 1985
Place: Denver, Colorado
Dates: November 12-14, 1985
Place: Calgary, Alberta, Canada
Objective: This seminar provides an in-depth examination of vibration measurement and machinery information systems as well as an introduction to diagnostic instrumentation. The three-day seminar is designed for mechanical, instrumentation, and operations personnel who require a general knowledge of machinery information systems. The seminar is a recommended prerequisite for the Machinery Instrumentation and Diagnostics Seminar and the Mechanical Engineering Seminar.

Contact: Customer Information Center, Bently Nevada Corporation, P.O. Box 157, Minden, NV 89423 - (702) 782-3611, Ext. 9243.

MACHINERY VIBRATION ANALYSIS AND CONTROL

Dates: April 23-26, 1985
Place: Cincinnati, Ohio
Objective: This course emphasizes the role of vibrations in mechanical equipment instrumentation for vibration measurement, techniques for vibration analysis and control, and vibration correction and criteria. Examples and case histories from actual vibration problems in the petroleum, process, chemical, power, paper, and pharmaceutical industries are used to illustrate techniques. Participants have the opportunity to become familiar with these techniques during the workshops. Lecture topics include: spectrum, time domain, modal, and orbital analysis; determination of natural frequency, resonance, and critical speed; vibration analysis of specific mechanical components, equipment, and equipment trains; identification of machine forces and frequencies; basic rotor dynamics including fluid-film bearing characteristics, instabilities, and response to mass unbalance; vibration correction including balancing and alignment; vibration control including isolation and damping of installed equipment; selection and use of instrumentation; equipment evaluation techniques; steam turbine balancing; and plant predictive and preventive maintenance. This course will be of interest to plant engineers and technicians who must identify and correct faults in machinery.

Contact: Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 West 55th Street, Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

MAY

VIBRATION AND SHOCK SURVIVABILITY, TESTING, MEASUREMENT, ANALYSIS, AND CALIBRATION

Dates: May 6-10, 1985
Place: Boston, Massachusetts
Dates: June 3-7, 1985
Place: Santa Barbara, California
Dates: August 26-30, 1985
Place: Santa Barbara, California
Dates: December 2-6, 1985
Place: Santa Barbara, California
Objective: Topics to be covered are resonance and fragility phenomena, and environmental vibration and shock measurement and analysis; also vibration and shock environmental testing to prove survivability. This course will concentrate upon equipments and techniques, rather than upon mathematics and theory.

Contact: Wayne Tustin, 22 East Los Olivos Street, Santa Barbara, CA 93105 -(805) 682-7171.

MACHINERY INSTRUMENTATION AND DIAGNOSTICS

Dates: May 6-10, 1985
Place: Carson, Nevada
Dates: June 4-7, 1985
Place: Pittsburgh, Pennsylvania
Dates: July 15-19, 1985
Place: Carson City, Nevada
Dates: September 10-13, 1985
Place: New Orleans, Louisiana
Dates: September 24-27, 1985
Place: Anaheim, California
Dates: October 8-11, 1985
Place: Philadelphia, Pennsylvania
Dates: October 21-25, 1985
Place: Carson City, Nevada
Dates: November 5-8, 1985
Place: Boston, Massachusetts
Dates: December 3-6, 1985
Place: Houston, Texas
Objective: This course is designed for industry personnel who are involved in machinery analysis programs. Seminar topics include a review of transducers and monitoring systems, machinery malfunction diagnosis, data acquisition and reduction instruments, and the application of relative and seismic transducers to various types of rotating machinery.

Contact: Customer Information Center, Bently Nevada Corporation, P.O. Box 157, Minden, NV 89423 - (702) 782-3611, Ext. 9242.

ROTOR DYNAMICS

Dates: May 6-10, 1985
Place: Syria, Virginia
Objective: The role of rotor/bearing technology in the design, development and diagnostics of industrial machinery will be elaborated. The fundamentals of rotor dynamics; fluid-film bearings; and measurement, analytical, and computational techniques will be presented. The computation and measurement of critical speeds vibration response, and stability of rotor/bearing systems will be discussed in detail. Finite elements and transfer matrix modeling will be related to computation on mainframe computers, minicomputers, and microprocessors. Modeling and computation of transient rotor behavior and nonlinear fluid-film bearing behavior will be described. Sessions will be devoted to flexible rotor balancing including turbogenerator rotors, bow behavior, squeeze-film dampers for turbomachinery, advanced concepts in troubleshooting and instrumentation, and case histories involving the power and petrochemical industries

Contact: Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 West 55th Street, Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

JUNE

VIBRATION CONTROL

Dates: June 3-7, 1985
Place: San Diego, California
Objective: This vibration control course will include all aspects of vibration control except alignment and balancing. (These topics are covered in separate Insti-

tute courses.) Specific topics include active and passive isolation, damping, tuning, reduction of excitation, dynamic absorbers, and auxiliary mass dampers. The general features of commercially available isolation and damping hardware will be summarized. Application of the finite element method to predicting the response of structures will be presented; such predictions are used to minimize structural vibrations, during the engineering design process. Lumped mass-spring-damper modeling will be used to describe the translational vibration behavior of packages and machines. Measurement and analysis of vibration responses of machines and structures are included in the course. The course emphasizes the practical aspects of vibration control. Appropriate case histories will be presented for both isolation and damping.

Contact: Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 West 55th Street, Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

AUGUST

MECHANICAL ENGINEERING

Dates: August 12-16, 1985
Place Carson City, Nevada
Objective: This course is designed for mechanical, maintenance, and machinery engineers who are involved in the design, acceptance testing, and operation of rotating machinery. The seminar emphasizes the mechanisms behind various machinery malfunctions. Other topics include data for identifying problems and suggested methods of correction.

Contact: Customer Information Center, Bently Nevada Corporation, P.O. Box 157, Minden, NV 89423 - (702) 782-3611, Ext. 9243.

MODAL TESTING OF MACHINES AND STRUCTURES

Dates: August 13-16, 1985
Place: Nashville, Tennessee
Objective: Vibration testing and analysis associated with machines and structures will be discussed in detail. Practical examples will be given to illustrate important concepts. Theory and test philosophy of modal techniques, methods for mobility measurements, methods for analyzing mobility data, mathematical modeling from mobility data, and applications of modal test results will be presented.

Contact: Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 West 55th Street, Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

MACHINERY VIBRATION ANALYSIS

Dates: August 13-16, 1985
Place: Nashville, Tennessee
Dates: Oct. 29 - Nov. 1, 1985
Place: Oak Brook, Illinois
Objective: This course emphasizes the role of vibrations in mechanical equipment instrumentation for vibration measurement, techniques for vibration analysis and control, and vibration correction and criteria. Examples and case histories from actual vibration problems in the petroleum, process, chemical, power, paper, and pharmaceutical industries are used to illustrate techniques. Participants have the opportunity to become familiar with these techniques during the workshops. Lecture topics include: spectrum, time domain, modal, and orbital analysis; determination of natural frequency, resonance, and critical speed; vibration analysis of specific mechanical components, equipment, and equipment trains; identification of machine forces and frequencies; basic rotor dynamics including fluid-film bearing characteristics, instabilities, and response to mass unbalance; vibration correction including balancing; vibration control including isolation and damping of installed equipment; selection and use of instrumentation; equipment evaluation techniques; shop testing; and plant predictive and preventive maintenance. This course will be of interest to plant engineers and technicians who must identify and correct faults in machinery.

Contact: Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 West

55th Street, Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

BALANCING OF ROTATING MACHINERY
Dates: August 13-16, 1985
Place: Nashville, Tennessee
Objective: This course will emphasize the practical aspects of balancing in the shop and field including training on basics, the latest techniques, and case histories. The instrumentation, techniques, and equipment pertinent to balancing will be elaborated with case histories. Demonstrations of techniques with appropriate instrumentation and equipment are scheduled. Specific topics include: basic balancing techniques (one- and two-plane); field balancing; balancing machines and facilities; use of programmable calculators; turbine-generator balancing; balancing sensitivity; factors to be considered in high speed balancing; effect of residual shaft bow on unbalance; tests on balancing machines; flexible rotor balancing --training and techniques; a unified approach to flexible rotor balancing; and coupling balancing.

Contact: Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 West 55th Street, Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

VIBRATION MEASUREMENT AND MODAL ANALYSIS
Dates: August 15-17, 1985
Place: Amherst, New York
Objective: This course covering dynamic and measurement systems, dynamic signals, applied signal analysis, vibration fundamentals and applied modal analysis will provide engineers with a background in both fundamental and applied aspects of vibration and modal testing. The course will be taught in a lecture/demonstration format making considerable in-class use of state of the art signal analysis and modal analysis instrumentation. Hands on lab experience will be available through informal evening sessions.

Contact: Mike Murphy, Kistler Instrument Corporation, 75 John Glenn Drive, Amherst, NY 14120 - (716) 691-5100.

OCTOBER

VIBRATIONS OF RECIPROCATING MACHINERY
Dates: Oct. 29 - Nov. 1, 1985
Place: Oak Brook, Illinois
Objective: This course on vibrations of reciprocating machinery includes piping and foundations. Equipment that will be addressed includes reciprocating compressors and pumps as well as engines of all types. Engineering problems will be discussed from the point of view of computation and measurement. Basic pulsation theory --including pulsations in reciprocating compressors and piping systems -- will be described. Acoustic resonance phenomena and digital acoustic simulation in piping will be reviewed. Calculations of piping vibration and stress will be illustrated with examples and case histories. Torsional vibrations of systems containing engines and pumps, compressors, and generators, including gearboxes and fluid drives, will be covered. Factors that should be considered during the design and analysis of foundations for engines and compressors will be discussed. Practical aspects of the vibrations of reciprocating machinery will be emphasized. Case histories and examples will be presented to illustrate techniques.

Contact: Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 West 55th Street, Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254.

NEWS BRIEFS: news on current and Future Shock and Vibration activities and events

40th MECHANICAL FAILURES PREVENTION GROUP SYMPOSIUM
Gaithersburg, Maryland
April 16-18, 1985

The 40th meeting of the Mechanical Failures Prevention Group will convene in Gaithersburg, Maryland during April, 1985, and it will be sponsored by the National Bureau of Standards, the Office of Naval Research, and the Army Materials and Mechanics Research Center. This symposium has become recognized as the outstanding forum for discussion of mechanical failure reduction as well as the development of methods to predict incipient failures. The purpose of this symposium is to aid communications among those involved with the reduction of mechanical failures through detection, diagnosis and prognosis (DD&P); durability evaluations; and the understanding of failure mechanisms. This year's symposium theme is: "Improvement in Mechanical Systems and Structures Readiness, Reliability and Maintainability through Application of New and Advancing Technology." The need to address this topic was focused in a recent study sponsored by the Office of the Secretary of Defense.

For further information contact: T. Robert Shives, Executive Secretary MFPG, Materials Bldg., Room A-113, National Bureau of Standards, Gaithersburg, Maryland 20899 - (301) 921-2934.

STANDARDS NEWS

Avril Brenig, Standards Manager

ASA Standards Secretariat, Acoustical Society of America
335 East 45 Street, New York, New York 10017

William A. Yost

Parmly Hearing Institute, Loyola University of Chicago, 6525 North Sheridan Road, Chicago, Illinois 60626

American National Standards (ANSI Standards) in the area of physical acoustics, bioacoustics, mechanical shock and vibration, and noise are published by the Acoustical Society of America (ASA). In addition to these standards, other Acoustical Society standards, a Catalog of Acoustical Standards—ASA Catalog 5—1984, and an Index to Noise Standards-ASA-STDS Index 2-1980 (national and international) are available from the Standards Secretariat of the Acoustical Society. To obtain a current list of standards available from the Acoustical Society, write to Avril Brenig, at the above address. Telephone number: (212) 661-9404.

Calendar

The next meetings of the ASA standards committees are scheduled for Austin, Texas, 8–12 April 1985.

1984 April 08, ASA Committee on Standards, 7:30 p.m., Thompson Conference Center, University of Texas. Meeting of the Committee that directs the ASA Standards Program.

1984 April 10, Accredited Standards Committee S2 on Mechanical Shock and Vibration (also Technical Advisory Group for ISO/TC/108 and IEC/SC/50A), 2:00 p.m., Thompson Conference Center, University of Texas. Review of international and S12 activities and planning for future meetings.

1984 April 11, Accredited Standards Committee S12 on Noise (also Technical Advisory Group for ISO/TC43/SC1), 9:30 a.m., Thompson Conference Center, University of Texas. Review of international and S12 activities and planning for future meetings.

1984 April 11, Accredited Standards Committees S1 (Acoustics) and S3 (Bioacoustics) (also Technical Advisory Group for ISO/TC/43, IEC/TC/29, and IEC/TC108/SC4), 1:30 p.m., Thompson Conference Center, University of Texas. The S3 meeting will be held first. Review of S1, S3, and international standards activities and planning for future meetings.

Editorial: Message from William Melnick, Standards Director of the Acoustical Society of America

The Acoustical Society and Acoustical Standards

Article II of the Bylaws of the Acoustical Society of America specifies that the purpose of the Society is "to increase and diffuse the knowledge of acoustics and promote its practical applications." The standards program epitomizes efforts of the members of ASA to promote the practical application of acoustic knowledge for public benefit. Hundreds of dedicated professionals contribute thousands of hours to fulfill this objective by developing and publishing standards acceptable to scientists, engineers, manufacturers, governmental regulating agencies, and consumers, both nationally and internationally. Standards have become an accepted part of our industrial and commercial way of life. Most of us give little thought to the origin of these standards and the tedious work involved in their development. We become aware of how much we depend on the existence of standardization in the efficient conduct of our daily activities only when there is no standardization or when there is a conflict in accepted standards. International travel makes this dependence irritatingly obvious!

The standards program of the ASA has a long history. Over 50 years ago, the Acoustical Society requested that the American Standards Association initiate a standardization program on acoustical measurement and terminology. In 1932, this request was granted and standardization activity in the Acoustical Society began. The Standards Committee Z24 was established to deal with acoustical terminology, noise measurement, fundamental acoustical measurements, sound absorption, and sound insulation with the Acoustical Society acting as its sponsor. The Z24 Committee was the progenitor of the four Accredited National Standards Committees for which the Acoustical Society now serves as Secretariat: S1—Physical Acoustics, S2—Mechanical Shock and Vibration, S3—Bioacoustics, and S12—Noise.

Standards developed under the auspices of the ASA have had a major impact on almost every technical area of acoustics. This standardization program has defined procedures used nationally and internationally for absolute and comparative calibration of measurement microphones; established performance characteristics of sound level meters, octave and 1/3-oct band filters, and personal noise dosimeters; prescribed procedures for measuring sound pressure and sound power levels; defined procedures for calibrating transducers used in shock and vibration measurements; provided methods for specifying performance of vibrating machines and damping properties of materials; established specifications and tolerances for audiometers and hearing aids; standardized techniques for evaluating effects of shock and vibration on people; and specified methods to be used in evaluating the performance of hearing protectors. Equally important projects for standardization in acoustics continue to be developed and revised to reflect the state of the art in technology and application.

On the international scene, similar standardization is accomplished by three technical committees of the International Electrotechnical Commission (IEC) and the International Organization for Standardization (ISO); IEC Technical Committee 29, Electroacoustics; ISO Technical Committee 43, Acoustics; and ISO Technical Committee 108, Mechanical Vibration and Shock. The Acoustical Society as Standards Secretariat for the four National Standards Committees plays a key role in organizing and establishing the position of the United States on proposed international standards. The principal objective is to harmonize as much as possible those standards used nationally with those accepted internationally. This is a particularly important function in international trade where technical standards are frequently used as barriers to restrict international industrial and commercial competition.

The standards program, just as other activities of the Society, is administered by the Executive Council. The Council implements this responsibility through the ASA Committee on Standards (ASACOS). The Chairman of ASACOS serves as the Society's Standards Director and is an ex officio member of the Executive Council. It is in this capacity that I have prepared this short editorial. Those of us active in standardization believe it to be an important activity of the Acoustical Society which merits the support and involvement of its membership. Join us!

 0001-4966/85/010328-01$00.80

Standards News from the United States

The following news items have been received since the last issue of Standards News:

ANSI moves Washington Office

The American National Standards Institute is moving its Washington office on 1 November 1984 to: 655 15th Street, NW, 300 Metropolitan Square, Washington, DC 20005. The new phone number is: (202) 639-4090.

ANSI is represented in Washington by Vincent D. Travaglini, who joined the Institute after a distinguished career in international trade and business practices. He is a former director of the US Department of Commerce's Office of International Finance, Investment, and Services. He was a member of the Business and Industry Panel, the White House Conference on International Cooperation, and the Tax Committee of the National Export Expansion Council. In the course of his career, he also served on many US delegations to international conferences on standards, technology transfer, patent and trademark problems, and other issues.

The American National Standards Institute is a private, nonprofit organization that coordinates the development of voluntary national standards, approves American National Standards, and represents US interests in the International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC).

ANSI receives Presidential award

The American National Standards Institute was awarded a Private Sector Initiative Commendation from President Ronald Reagan at a White House Conference on Association Self-Regulation held earlier this month.

ANSI was recognized for its national voluntary standards and certification program and its service as a clearinghouse for nationally coordinated voluntary safety, engineering, and industrial standards.

The award was accepted by Institute President Donald L. Peyton.

Several members of the Institute were also recognized for their self-regulation programs. They are: the American Dental Association, the American Optometric Association, the Association of Home Appliance Manufacturers, the Electronic Industries Association, and the Gas Appliance Manufacturers Association.

The White House Conference on Association Self-Regulation is sponsored by the White House Office of Private Sector Initiatives and the American Society of Association Executives. Its purposes include encouraging more private sector associations to develop self-regulation projects and recognizing outstanding existing programs through Presidential Awards.

The American National Standards Institute is a private, nonprofit organization that coordinates the development of voluntary national standards, approves American National Standards, and represents US interests in the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC).

New safety catalog available from ANSI

ANSI's 1984–1985 Catalog of American National Standards for Safety and Health has just been published. This edition lists all new and revised safety and health standards approved by ANSI since the previous edition was published in September 1983.

The 900 standards listed provide authoritative guides to industrial safety and to protection of the individual. The standards in the catalog are divided into ten categories: agriculture, construction, consumer and recreational products, electrical devices and wiring, fire protection, health, highway and traffic, nuclear, occupational safety, and security.

The 32-page safety and health catalog is now available free of charge from the Institute's Sales Department.

Standards approved and published by ANSI

The following standards were approved and published by the ASA:

ANSI/ASC S1.6-1984	"Preferred Frequencies, Frequency Levels, and Band Numbers for Acoustical Measurement (revision and redesignation of ANSI S1.6-1967)"
ANSI/ASC S1.40-1984	"Specifications for Acoustical Calibrators"
ANSI/ASC S2.34-1984	"Experimental Determination of Rotational Mobility Properties and the Complete Mobility Matrix, Guide to"

The above standards are available from the Standards Secretariat at the following address: AIP Publication Sales Department, Department STD, 335 East 45th Street, New York, NY 10017. (A 20% discount is available to individual and sustaining members of the Society.)

International documents on acoustics received in the United States

The documents listed below have been received by the Standards Secretariat of the Society and have been announced to S1, S2, S3, or S12. The document number is listed to the left of each document and the Accredited Standards Committee to which the document was announced is listed in parentheses below the document number. Further information on each document can be obtained from the Standards Secretariat.

The following documents have been received from ISO for vote:

ISO/DIS 8002 (S2)	Mechanical vibrations of land vehicles—method for reporting measured data
ISO/DIS 226 (S3)	Acoustics—Normal equal-loudness contours for pure tones under free-field listening conditions
ISO/DIS 7566 (S3)	Acoustics—Standard reference zero for the calibration of pure-tone bone-conduction audiometers
ISO/DIS 8253 (S3)	Acoustics—Pure-tone audiometric test methods

The following documents have been received from IEC for vote:

IEC/TC 29 (Central Office) 139	Draft—IEC report 118-10: guide to hearing aid standards

Standards from other Standards Organizations

The following document has been received from OIML for comment:

SP14/SR1	Proposed OIML draft—sound-level meters

Report on ISO/TC/108 Mechanical Vibration and Shock

The following information about the resolutions of ISO/TC 108 adopted at the final ISO/TC meeting held 6 September 1984 in Berlin, West Germany is provided below:

RESOLUTION 1

New work item for ISO/TC 108/SC 1. TC 108 recognizes the request of TC 108/SC 1 to establish a new work item for developing a document on Errors Associated With Residual Unbalance and Methods for Determining Unbalance of a Rigid Rotor with the following preliminary scope:

> This document describes errors associated with residual unbalance and their sources, how to take the errors into account, and methods for determining the residual unbalance in two correction planes of a rigid rotor.
>
> This proposed new work item will be circulated to TC 108 for ballot.

RESOLUTION 2

TC 108/SC 1 approval of ISO/DIS 2953 "Balancing machines—Description and evaluation" and submission to ISO Council. TC 108 recognizes the proposed action of TC 108/SC 1 to approve ISO/DIS 2953 and return the corrected text to the ISO Central Secretariat for submission to the Council.

RESOLUTION 3

Submission of Revision of ISO 1940-1973 "Balance quality of rotating rigid bodies" to ISO. TC 108 recognizes the proposed action of TC 108/SC

1 in revision of ISO 1940-1973, with revisions of relatively minor importance, and submission of the revised document to the ISO Central Secretariat for publication under the abbreviated procedure as a revised edition of the standard.

RESOLUTION 4

ISO 2371-1974 "Field Balancing Equipment." TC 108 will await the results of the implementation inquiry from ISO before any decision can be taken on this standard.

RESOLUTION 5

Confirmation of ISO 2372/Amendment 1. TC 108 recognizes the proposed action of TC 108/SC 2 to confirm without change ISO 2372/Amendment 1.

RESOLUTION 6

Request from TC 108/SC 2 to delete work item no. 49. TC 108 accepts the proposed request from SC 2 that work item no. 49 "Proposed Basis Document for the Measurement and Evaluation of Machinery Vibration" should be deleted from the TC 108 program of work.

RESOLUTION 7

Scope of TC 108/SC 2. TC 108 notes receipt of the wording of the SC 2 scope, subject to approval by TC 108/SC 2.

RESOLUTION 8

TC 108 comments on document submitted by ISO/TC 60. TC 108 accepts the decision of SC 2/WG 1 regarding working group document ISO/TC 60/WG 9 N 41 E, submitted by ISO/TC 60 for review by ISO/TC 108, in that it fails to meet the requirements of the measurement and evaluation procedures developed by SC 2. TC 108 will return the document to ISO/TC 60 with technical comments as given in 108/SC/WG 1 N 115.

RESOLUTION 9

TC 108 recognizes the decision of SC 2/WG 1 to request SC 2 to establish liaison with ISO/TC 60 "Internal Combustion Engines."

RESOLUTION 10

Revised text of ISO 2041-1975 "Vibration and Shock—Vocabulary" to be submitted to ISO as a DIS. TC 108 agrees to submit the proposed revision of ISO 2041-1975 (working group document N 122, as amended at the Berlin meeting) to the ISO Central Secretariat for publication as a DIS.

In the interest of expediting publication, TC 108 agrees to implement Council resolution no. 45/1983 (i.e., to ask the ISO Central Secretariat to dispense with the need for a French translation at this time).

RESOLUTION 11

Revision of ISO/DIS 4865 "Vibration and shock—Methods for analysis and presentation of data" in accordance with proposed revision of ISO 2041-1975. TC 108 will implement the changes to terms and definitions contained in ISO/DIS 4865 to make it compatible with the latest proposed revision of ISO 2041-1975 (see resolution no. 10).

RESOLUTION 12

ISO/DP 8626 "Mechanical Vibration and Shock—Characteristics of servo-hydraulic test equipment for generating vibration" to be submitted to ISO as a DIS. Following TC 108 vote on ISO/DP 8626, TC 108 will submit the revised text as edited by experts (Editing Committee) in Berlin, at the request of the TC 108 Secretariat, based on 108 N 403 (comments). The revised text will be submitted to ISO for registration as a DIS.

RESOLUTION 13

New work item for TC 108/WG 4. TC 108 will circulate a proposal for a new work item (for TC 108/WG 4) in the form of a guidance document with the following preliminary scope and rationale:

> This document is an aid to equipment users in the selection of a particular type of grade of vibration test requirements (as identified in ISO 5344, ISO 6070, and ISO/DIS 8626) and will include data and characteristics which are common to all three categories of equipment.

RESOLUTION 14

Work of ISO/TC 108/WG 11 "Analytical method for assessing the shock resistance of mechanical systems." The revision of TC 108/WG 11 N 25 (108/WG 11 N 29) as prepared at Berlin, will be sent to TC 108/WG 11 for comment by December 1984. Based on the responses, a second draft will be sent to the working group by mid-1985. If approval is obtained on this second draft, it will be sent to TC 108 as a Draft Proposal.

RESOLUTION 15

Convenor of TC 108/WG 13 "Use of materials for damping of vibrating structures" and preparation of revised text (based on 108 N 371). TC 108 appoints Dr. L. Rogers as Convenor of TC 108/WG 13 and urges that the revised document (based on 108 N 371, prepared at the September 1983 meeting held in Sweden but not circulated) be received for circulation to the working group by March 1985.

RESOLUTION 16

Two new work items for TC 108/WG 14 "Mechanical Mobility." Two new work items are proposed for this working group, to become parts 6 and 7 of the basic mobility document series. The proposed scopes of these documents will be circulated to TC 108 with the ballot forms.

RESOLUTION 17

Approval of ISO/DP 8568 "Shock Testing Machines" for circulation as a DIS. TC 108 approves ISO/DP 8568 to be revised in accordance with the comments received on the ballot (108N 381, 382, and 396) and to be submitted to ISO for registration as a DIS.

RESOLUTION 18

Second draft of document on vibration sensitive equipment to be proposed for TC 108 vote. In view of the comments received on the first draft of ISO/DP 8569 "Vibration Sensitive Equipment—Guide for the method of measurement and evaluation of vibration effects," TC 108 instructs TC 108/WG 16 (Methods for measuring and reporting data on vibration and shock resistance of motion sensitive equipment) to prepare a Second Draft Proposal for vote of TC 108.

RESOLUTION 19

Report from the UN Economic Commission for Europe. TC 108 notes the transmittal of the request by ISO from the UN Economic Commission for Europe (UN/ECE) for a list of documents and standards to be listed according to certain criteria as follows:

(a) those documents which governments might consider appropriate to use in drawing up regulations concerning public safety and health, (b) environmental protection and pollution control, (c) rational utilization of energy and raw materials, and (d) wherever the lack of harmonized standards might create technical obstacles to international trade.

TC 108 agreed to submit the TC 108 annual report modified with a list of documents by the categories noted above.

RESOLUTION 20

Result of voting on 3rd ISO/DP 8041 "Human response vibration measuring instrumentation" and preparation as a DIS. Following comments received on the first calculation of 108 N 400 "3rd ISO/DP 8041—Human response vibration measuring instrumentation," TC 108 recognizes that this document as revised during the meeting on the basis of the comments given in document 108 3 N 149, and subject to final editing by SC 3, will be submitted for circulation as an ISO/DIS.

RESOLUTION 21

More efficient processing of Draft International Standards. TC 108 agrees to investigate the possibility of more efficient processing of DISs, including not waiting for the French text where the text is not readily available within a reasonable period of time (implementation of ISO Council resolution no. 45/1983) (with particular reference to the printing of ISO/DIS 5347).

RESOLUTION 22

New work item for ISO/TC 108/SC 3. TC 108 recognizes the request of SC 3 for a new work item entitled "Basic document for vibration measurement instrumentation requirements" with the scope to be sent to TC 108 with the ballot form.

RESOLUTION 23

Approval and assignment of new work items. TC 108 recognizes the approval of the following work items and their assignment as follows:

New work items:		Assigned to:
No. 46	Instrumentation for the measurement of vibration in buildings	SC 3 (from SC 2)
No. 92	Revision of ISO 5805-1981	SC 4
No. 95	Revision of ISO 3945-1977	SC 2
No. 96	Characterization of railway environments (formerly SC 4/WG 2 document)	SC 2
No. 97	Shaft Key Convention	SC 1
No. 89	Uniform representation of shock data	TC 108
No. 90	Characterization and graphical representation of linear damping material properties	TC 108
No. 91	Multilingual guide to balancing machine terminology	SC 1
No. 94	Combined model for whole-body impedance and transmissibility (Addendum to ISO 5982)	SC 4
No. 93	Standard taxonomy of vibration and motion-sensitive human activity and performance	SC 4

RESOLUTION 24

ISO/DP 7626, part 2 "Methods for experimental determination of mechanical mobility—Part 2: Mobility measurements using translational excitation at a single point" to be submitted as a DIS. TC 108 approves ISO/DP 7626 part 2 which has been transmitted to ISO for registration as a DIS.

RESOLUTION 25

Next meeting of ISO/TC 108 and Subcommittees. The next meeting of ISO/TC 108 and its four Subcommittees (subject to their individual confirmation) is expected to be held in the Spring of 1986, probably in Prague (CSSR). The dates will probably be early April 1986.

RESOLUTION 26

Appreciation to Hosts. Thanks and appreciation are expressed to DIN, and its most able staff, for extending the use of their facilities and great hospitality to TC 108, Subcommittees, and Working Groups, which met together at this meeting in Berlin.

Report on IEC/SC 50A

The following information about the activities of IEC/50 A Subcommittee on Shock and Vibration is provided below:

This IEC subcommittee covers the development, improvement, and periodic review of the test methods in IEC Publ. 68 on Shock, Vibration, Bump, Acoustical, and Seismic testing.

Since many of the shock and vibration test methods have been in use for many years the committee work now consists primarily of improvement of these tests methods and their associated procedures as well as the development of the more exotic test methods involving very high-frequency, sound, or seismic testing.

The last meeting of the committee was held in Milan, Italy on 4 and 5 June, 1984. Attendance at the meeting consisted of 32 delegates from 13 countries. Representing the US was Glenn W. Carter, Technical Advisor for SC 50A from the United States National Committee, and Eric Heberlein, Chairman of Working Group 8 on Seismic Testing Procedures.

Committee activity consisted of the following:

(1) Improvement and addition of new requirements, including mounting requirements, to the shock and vibration tests which are now in IEC Publ. 68.

(2) Random vibration confirmation methods will be developed and a new working group is being formed for this purpose.

(3) Working Group 8 on seismic testing developed test procedures and is continuing that effort. Eric Heberlein of the US is in charge of that work.

(4) A decision was made that a new acoustical vibration working group would prepare an initial draft of a testing procedure which would be issued as a Secretariat Document to all National Committees. US participation is necessary.

United States Technical Experts are needed to participate in the individual working group activities. In addition to being outstanding experts in the field of work involved, the experts must have financial support to attend one or two meetings a year of the working group (the meetings are generally in Europe) and take an active part in the development of test method initial drafts. There is no US government or industry association support for these travel expenses.

Specific working groups which now need experts are as follows:

1st Working Group—Random Vibration/Confirmation Methods and Revisions of Test Procedures. Task—To produce a proposal for an IEC Document giving nonmandatory information dealing with confirmation methods for the random vibration tests, Test Fd of IEC Publ. 68. The document will cover possible instrumentation errors, statistical errors, and analyzing errors. Also, to update and revise the test method.

2nd Working Group—Acoustic Vibration Test. Task—To produce an Environment Acoustic Vibration Test suitable for components and equipment. This should be based on the preliminary proposals 50A (Secretariat) 199 and 50A Milan/France/8 (these documents are available from ASA).

Anyone who can participate in these working groups, or can attend the international committee meetings representing one of the areas of interest is encouraged to become active.

Report on Other Standards Activities

Standards News has received a report from ASTM Committee E-33 on Environmental Acoustics.

A new task group on Ceiling Insertion Loss Measurements was formed by the American Society for Testing and Materials (ASTM) Committee E-33 on Environmental Acoustics. The group was formed during the 15–17 October 1984 meetings of Committee E-33 in Norfolk, Virginia.

The new task group will examine ways to measure how well the noise from an air conditioning unit directly above a suspended ceiling can be isolated from the space below. The task group hopes to develop a method to measure or calculate the insertion loss provided by ceiling products used beneath such air-conditioning units.

The task group on the two-room method has prepared a draft method to measure the sound insulation between two rooms sharing a common ceiling and plenum. The group is organizing a round robin test series using three ceiling materials, gypsum board, mineral fiber ceiling board, and fiberglass ceiling board. Laboratories that want to participate in the round robin should contact the task group Chairman, Dr. Mark A. Lang, Owens–Corning Fiberglas Corporation, P. O. Box 415, Granville, Ohio 43023; telephone: (614) 587-8138.

The task group on Fixed and Demountable Partitions is reviewing Recommended Practice E 497 for "Installation of Fixed Partitions of Light Frame Type for the Purpose of Conserving Their Sound Insulation Efficiency" and Practice E 557 for "Architectural Application and Installation of Operable Partitions." The group seeks comments and recommendations from users for possible revisions.

Revisions to Specification C 635 for "Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings" and Practice C 636 for "Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels" are being made by the task group on Metal Suspension Systems. The revisions will add sections to cover conditions in severe environments.

The task group on Airflow Resistance is organizing a round robin test series to provide data on the precision of Test Method C 522 for "Airflow Resistance of Acoustical Materials." Laboratories interested in participating in the round robin can contact the task group Chairman, Keith W. Walker, U. S. Gypsum Company, P. O. Box 460, Round Lake, Illinois 60073; telephone: (312) 546-8288.

The task group on Open Office Recommended Practices is preparing recommended practices to aid designers of landscape offices.

The task group on Community Noise announced that Method E-1014 for "Measurement of Outdoor A-Weighted Sound Levels" has been approved by the ASTM Committee on Standards and will be published shortly.

The next E-33 meeting will be in Pittsburgh, Pennsylvania on 22–24 April 1985. For more information about Committee E-33 and its activities contact David R. Bradley, ASTM, 1916 Race Street, Philadelphia, Pennsylvania 19103, telephone: (215) 299-5504.

ABSTRACTS FROM THE CURRENT LITERATURE

ABSTRACT CONTENTS

AVAILABILITY OF PUBLICATIONS ABSTRACTED

None of the publications are available at SVIC or at the Vibration Institute, except those generated by either organization.

Periodical articles, society papers, and papers presented at conferences may be obtained at the Engineering Societies Library, 345 East 47th Street, New York, NY 10017; or Library of Congress, Washington, D.C., when not available in local or company libraries.

Government reports may be purchased from National Technical Information Service, Springfield, VA 22161. They are identified at the end of bibliographic citation by an NTIS order number with prefixes such as AD, N, NTIS, PB, DE, NUREG, DOE, and ERATL.

Ph.D. dissertations are identified by a DA order number and are available from University Microfilms International, Dissertation Copies, P.O. Box 1764, Ann Arbor, MI 48108.

U.S. patents and patent applications may be ordered by patent or patent application number from Commissioner of Patents, Washington, D.C. 20231.

Chinese publications, identified by a CSTA order number, are available in Chinese or English translation from International Information Service, Ltd., P.O. Box 24683, ABD Post Office, Hong Kong.

When ordering, the pertinent order number should always be included, <u>not</u> the **DIGEST** abstract number.

A List of Periodicals Scanned is published in issues, 1, 6, and 12.

MECHANICAL SYSTEMS

ROTATING MACHINES

85-445
Torsional and Flexural Vibrations in Drive Systems: A Computer Simulation
A. Laschet, C. Troeder
Maschinenbau Entwicklung Consulting GmbH, Eschweiler, W. Germany
Computers Mech. Engrg., 3 (2), pp 32-43 (Sept 1984), 20 figs, 14 refs

KEY WORDS: Mechanical drives, Torsional vibrations, Flexural vibrations, Computer programs

The simulation of torsional and flexural vibrations in a drive system is considered. A package of computer programs written for these tasks (Simgen, Simul, Fanlys, and Klass) is described. The Fortran source code for this package, which runs on a Prime 750 computer, is approximately 30,000 lines long.

85-446
Vibrations in Rotating Machinery
A.G. Parkinson
The Open Univ., Walton Hall, Milton Keynes MK7 6AA, UK
ISBN O 335 10602 1, 26 pp (Feb 1984)

KEY WORDS: Rotors, Shafts

This is the text of lecture delivered at the Open University on March 16, 1982. Topics include the basic concepts of vibration, unbalance in rotating shafts, vibration of flexible rotating shafts, and computation and numerical models.

85-447
Vibrations of a Rotating Shaft with Rotating Nonlinear Restoring Forces at the Major Critical Speed
T. Yamamoto, Y. Ishida, T. Ikeda
Nagoya Univ., Chikusa-ku, Nagoya, Japan
Bull. JSME, 27 (230), pp 1728-1736 (Aug 1984), 9 figs, 13 refs

KEY WORDS: Shafts, Initial deformation effects, Critical speeds

This paper deals with a nonlinear forced oscillation at a major critical speed in a bent rotating shaft. An unsymmetrical bent shaft carrying a disc or a bent round shaft (a shaft with circular cross section) carrying an unsymmetrical rotor is supported by single-row deep groove ball bearings having angular clearances The nonlinear spring characteristic fluctuates with shaft rotation due to the initial bend. A nonlinear restoring force rotates with the shaft. The resonance curves at the major critical speed in this system are more complicated in shape than those in a straight shaft system, and their shapes vary with the angular position of the rotor unbalance.

85-448
Lateral Vibrations of a Rotating Shaft Driven by a Universal Joint (1st Report, Generation of Even Multiple Vibrations by Secondary Moment)
H. Ota, M. Kato
Nagoya Univ., Chikusa-ku, Nagoya, Japan
Bull. JSME, 27 (23), pp 2002-2007 (Sept 1984), 8 figs, 9 refs

KEY WORDS: Shafts, Universal joints, Lateral vibrations

The causes and characteristics of lateral vibrations occurring when a rotating shaft is driven by a universal joint (Hooke's joint) are the subject of this study. Dynamical considerations are related to the mechanism of a moment transmitted by the universal joint. The analytical results regarding a secondary moment generated by the universal joint show that a driven shaft has a number of forced vibrations owing to the secondary moment. Each of these vibrations makes a resonance when an angular velocity of the drive shaft coincides with one of the even integer submultiples of natural angular frequencies in

the driven shaft system. The experimental results show good agreement with the analytical results.

85-449

Transverse Vibration of a Rotor System Driven by a Cardan Joint

T. Iwatsubo, M. Saigo
Kobe Univ., Rokkodai Nada, Kobe, Japan

J. Sound Vib., 95 (1), pp 9-18 (July 8, 1984), 9 figs, 5 refs

KEY WORDS: Rotors, Universal joints, Flexural vibrations

The transverse vibration of a rotor system driven by a Cardan joint is analyzed, and the effect of the transmitted torque on the dynamic stability of the system is evaluate. When the driving shaft and driven shaft (rotor shaft) are included, both parametric and self-excited vibrations arise due to transmitted torque. Asymmetrical stiffness of the rotor supports has the effect of stabilizing this self-excited vibration.

85-450

A Simplified Method for Calculating Torsional Vibration of Shafting with Damper

Zhu Menghua

Ship Engrg. (6), p 50 (1983), CSTA No. 623.8-83.68

KEY WORDS: Shafts, Torsional vibrations, Dampers

This paper contains the theory of simplified method for calculating the torsional vibration of a damped shafting. Compared with other methods, it can reduce the work involved in calculation.

85-451

Influence of Load Torque on Stability of Rotor Driven by Flexible Shaft

R. Cohen, I. Porat
Faculty of Mech. Engrg., Technion -- Israel Inst. of Technology, Haifa, Israel

J. Sound Vib., 95 (2), pp 151-160 (July 22, 1984), 8 figs, 8 refs

KEY WORDS: Flexible rotors, Torque excitation

The influence of the load torque on the stability of a symmetric rotor, driven by a flexible shaft is studied. Both linear and angular displacements of the rotor are considered in this approximate analysis. Deflection, damping and load torque are assumed to be small. The main destabilizing effect of the load torque is due to transverse moments when the rotor is inclined. The reaction pattern at the ends of the shaft, determined by Kirchhoff equations, indicates that the semi-tangential mode of loading (conservative) is operative.

85-452

A General Method of Analysis for Dynamic Problems of Rotor Systems

M. Ichimonji, H. Yamakawa
Heavy Apparatus Lab. Toshiba Corp., 2-4 Suehiro-cho, Tsurumi-ku, Yokohama, Kanagawa 230, Japan

Bull. JSME, 27 (230), pp 1716-1722 (Aug 1984), 7 figs, 1 table, 5 refs

KEY WORDS: Modal analysis, Rotors, Critical speeds, Ground motion

A finite element complex modal analysis method modified with a dummy gyroscopic matrix is presented. It is applicable to various types of dynamic response problems of rotor systems. Numerical examples show the validity and effectiveness of the proposed method. The method was used to solve the dynamic response of a rotor system passing through its critical speeds; the base was subjected to a ground motion.

85-453

Vibration of Impellers (6th Report, Vibration Analysis at Moving Coordinates Fixed in Rotating Impellers (1st))

S. Michimura, A. Nagamatsu, N. Hagiwara, K. Kikuchi
Tokyo Inst. of Technology, 2-12-1 Ohokayama Meguro-ku, Tokyo, 152 Japan
Bull. JSME, 27 (23), pp 1990-1995 (Sept 1984) 5 figs, 17 refs

KEY WORDS: Impellers, Rotating structures, Centrifugal forces, Coriolis forces, Finite element technique

Dynamic characteristics of stationary impellers can be analyzed accurately by the cyclic symmetry method; however, it is necessary to calculate dynamic characteristics of rotating impellers. In this report, equations of motion and those of vibration for rotating impellers are divided into finite elements. Effects of centrifugal forces and Coriolis' forces are considered. It is clear that critical speeds and critical modes can be found in connection with centrifugal forces and that computation of natural pairs considering Coriolis' influence resolves into eigenvalue problems of Hermitian matrices.

85-454

Vibration of Impellers (7th Report, Vibration Analysis at Moving Coordinates Fixed in Rotating Impellers (2nd))

S. Michimura, A. Nagamatsu, N. Hagiwara, K. Kikuchi
Tokyo Inst. of Technology, 2-12-1 Ohokayama Meguro-ku Tokyo, 152 Japan
Bull. JSME, 27 (23), pp 1996-2001 (Sept 1984), 7 figs, 4 refs

KEY WORDS: Impellers, Natural frequencies, Mode shapes, Finite element technique

Natural frequencies and modes of rotating impellers are analyzed by a method based on the finite element method and the cyclic symmetry method. The cyclic symmetry method is efficient in analyzing dynamic characteristics of rotating impellers accurately. It is sufficient to calculate each substructure of all rotating impellers in the same manner as stationary impellers because impellers are generally regarded as periodically symmetric when rotating around axes of their structural symmetry. This proposed method is applied to a practical impeller; calculated results are compared with experimental ones.

RECIPROCATING MACHINES

85-455

Combustion Noise in S.I. Engines (Verbrennungsgeräusch des Ottomotors)

J. Borggrafe, J. Berthold
Automobiltech. Z., 86 (7/8), pp 333-338 (July/Aug 1984), 8 figs, 8 refs (In German)

KEY WORDS: Combustion engines, Noise reduction, Combustion noise

This method of analysis estimates combustion-induced noise at a very early stage of development. The method transforms a time signal for combustion pressure into a frequency signal. Overall engine noise and combustion noise can be specified on the basis of engine attenuation and mechanical noise. Application of this method to various shapes of combustion chambers and curves of combustion pressure reveals room for optimization.

85-456

Modelling the Exhaust Noise Radiated from Reciprocating Internal Combustion Engines - A Literature Review

A.D. Jones
Hills Industries Limited, P.O. Box 78, Clarence Gardens, South Australia 5039, Australia
Noise Control Engrg. J., 23 (1), pp 12-31 (July/Aug 1984), 12 figs, 86 refs

KEY WORDS: Internal combustion engines, Reciprocating engines, Sound waves, Wave propagation

Linear acoustic analysis of exhaust system components together with measurements of sound source and atmospheric characteristics have enabled radiated noise to be determined for only a few cases. Modeling full nonlinear unsteady exhaust gas flow is also difficult for complex engine and exhaust system combinations, but radiated exhaust noise has been determined by this method. The fundamentals of both methods are briefly covered. The development and application of these techniques in modeling reciprocating engine exhaust noise are reviewed. The limitations of the approaches are considered; possibilities for future work are mentioned.

85-457

Basic Research on Vibration and Noise of Internal Combustion Engine (2nd Report, Noise Analysis of Cylinder Block)

M. Nagaike, A. Nagamatsu, S. Kumano
Tokyo Inst. of Technology, 12-1, Ohokayama 2-chome, Meguro-ku, Tokyo, 152, Japan

Bull. JSME, 27 (230), pp 1723-1727 (Aug 1984), 14 figs, 4 refs

KEY WORDS: Internal combustion engines, Noise generation

Distributions and frequency characteristics of sound pressures emitted from the surface of a cylinder block of an internal combustion engine are analyzed. Vibratory transfer functions of the cylinder block are analyzed by the component mode synthesis method. Modal damping of the cylinder block obtained experimentally by harmonic excitation is used in a vibration analysis of the cylinder block. Distribution and frequency characteristics of sound pressures are analyzed using the vibratory transfer functions calculated by the component mode synthesis method. Vibratory transfer functions obtained in experiment are used in a noise analysis. The calculated results agree closely with the experimental ones.

METAL WORKING AND FORMING

85-458

Investigations on Vibratory Burnishing Process

S.S. Pande, S.M. Patel
Indian Inst. of Technology, Powai, Bombay-400 076, India

Intl. J. Mach. Tool Des. Res., 24 (3), pp 195-206 (1984), 14 figs, 4 tables, 13 refs

KEY WORDS: Metal working, Vibratory techniques

Experimental investigations on a vibratory ball burnishing process are reported. Experiments studied the influence of such parameters as burnishing speed, feed, ball force, frequency and amplitude of vibration on the surface finish, and microhardness of surface layers produced by vibratory burnishing process. These experiments were based on response surface methodology (RSM) technique. Two mathematical models correlating process parameters with response parameters (viz., surface roughness R_a and microhardness) were obtained. These models can be used to select optimum process parameters for obtaining desired controlled surface characteristics.

85-459

Suppression of Self-Excited Vibration by the Spindle Speed Variation Method

K. Jemielniak, A. Widota
Warsaw Technical Univ., ul. Narbutta 86, 02-524 Warsaw, Poland

Intl. J. Mach. Tool Des. Res., 24 (3), pp 207-214 (1984), 9 figs, 10 refs

KEY WORDS: Machine tools, Spindles, Self-excited vibrations, Vibration control

A method to analyze the influence of spindle speed variation on the course of self-excited vibration is presented. This analysis is based on the influence of the frequency of self-excited vibration on the stability of machining and dependence of this frequency on workpiece rotational speed. The influence of the spindle-speed variation frequency and amplitude on chatter is investigated.

85-460

Damping of Elements and Workpieces during Flexural Vibrations (Untersuchungen zur

Element- und Werkstuckdampfung bei Biegeschwingungen)**
H. Sollman
Technische Universität Dresden, German Dem. Rep.
Maschinenbautechnik, 33 (6), pp 258-262 (1984), 8 figs, 2 tables (In German)

KEY WORDS: Machine tools, Damping coefficients, Flexural vibrations

An experimental procedure for the measurement of machine tool element damping is described. From the measurement results the damping of the workpiece is calculated and the effect of cross section and type of vibration is discussed. Experimental results are compared with calculations by means of a stationary forced damped flexural vibration example.

85-461
Parameter Identification and Modification of Dynamic Properties of Machine Tools (Parameter-Identifikation und Modifikation der dynamischen Eigenschaften von Werkzeugmaschinen)
K. Marchelek, S. Berczynski, A. Witek
Technische Hochschule Szczecin, Poland
Maschinenbautechnik, 33 (8), pp 367-372 (1984), 9 figs, 1 table (In German)

KEY WORDS: Machine tools, Parameter identification technique, Stiffness coefficients, Damping coefficients, Finite element technique

Algorithms to determine rigidity and damping parameters of vibration models of rigid finite elements by test values as well as for model modification are shown. The considerations of sensitivity go beyond the method of rigid finite elements. For a real machine tool interesting results are shown.

85-462
Level and Tendencies of Development of Dynamics of Cutting Machine Tools (Stand und Entwicklungstendenzen der Dynamik spanender Werkzeugmaschinen)
F. Erfurt, W. Tietz
Technische Hochschule Karl-Marx-Stadt, Sektion Maschinen-Bauelemente
Maschinenbautechnik, 33 (6), pp 275-280 (1984), 4 figs, 1 table, 75 refs (In German)

KEY WORDS: Machine tools, Cutting, Vibration measurement, Computer-aided techniques

Certain aspects of cutting machine tools (influence of joints, feedback via cutting process) make high demands on the measurement technology of vibrations as well as the pre-calculation of dynamic properties. Formation of computer-aided systems of measurement, improvement of modeling accuracy, reduction of number of degrees of freedom, approximation of stiffness and damping of joints from measured values are some of the most important problems.

ISOLATION AND ABSORPTION

85-463
Optimal and Suboptimal Linear Active Suspensions for Road Vehicles
A.G. Thompson
M.I.T., Cambridge, MA 02139
Vehicle Syst. Dynam., 13 (2), pp 61-72 (Aug 1984), 4 figs, 1 table, 6 refs

KEY WORDS: Suspension systems (vehicles), Active isolation, Ground vehicles

Acceleration feedback allows a body spring of arbitrary stiffness to be incorporated in an active suspension design without loss of optimality. The necessary body position feedback can be measured relative to the axle rather than to the road. This entails only a slight loss in performance and results in a suboptimal system with a simplified feedback structure. The effects of the performance index weighting factors on the eigenvalues of the optimal system are discussed.

85-464
Design of a Longitudinal Railway Vehicle Suspension System to Ensure the Stability of a Wheelset

R.V. Dukkipati, R.R. Guntur
National Res. Council of Canada, Ottawa, Canada
Intl. J. Vehicle Des., 5 (4), pp 451-466 (July 1984), 16 figs, 1 table, 6 refs

KEY WORDS: Suspension systems (vehicles), Railroad trains, Stability, Wheelsets

To facilitate the design of the longitudinal suspension of a wheelset a method has been proposed with which it is possible to draw stability boundaries on a parameter plane.

STRUCTURAL SYSTEMS

BRIDGES

85-465
Traffic Generated Vibrations and Bridge Integrity
H.S. Ward
Hong Kong Polytechnic, Hung Hom, Kowloon, Hong Kong
ASCE J. Struc. Engrg., 110 (10), pp 2487-2498 (Oct 1984), 5 figs, 3 tables, 5 refs

KEY WORDS: Bridges, Moving loads, Traffic-induced vibrations, Testing techniques

Measurements of bridge vibrations generated by the normal passage of vehicles were analyzed to determine the dynamic characteristics of the bridges. A preliminary investigation of the possible assessment of structural integrity was made using these measurements. One diagnostic tool is a plot of fundamental frequency span. A second possibility is an analysis of overall vibration levels on the bridge relative to the energy input created by traffic. Further work should include a comparison with other proven experimental techniques as well as support based on theoretical predictions of bridge characteristics.

85-466
Natural Frequencies and Modes of Suspension Bridges
H.H. West, J.E. Suhoski, L.F. Geschwindner, Jr.
Pennsylvania State Univ., University Park, PA 16802
ASCE J. Struc. Engrg., 110 (10), pp 2471-2486 (Oct 1984), 8 figs, 5 tables, 9 refs

KEY WORDS: Suspension bridges, Natural frequencies, Mode shapes

The natural frequencies and corresponding mode shapes of a stiffened suspension bridge are determined. The changes that occur in these characteristics with respect to parametric changes in the bridge are examined. A single-span, planar structure with hangers and flexible cable supports is used to model a suspension bridge. The derivation of the governing equation of motion for the model is sufficiently general to be applied to a multi-span system; however, only a single-span case is studied.

85-467
Torsional Earthquake Response of Suspension Bridges
A.M. Abdel-Ghaffar, L.I. Rubin
Princeton Univ., Princeton, NJ 08544
ASCE J. Engrg. Mech., 110 (10), pp 1467-1487 (Oct 1984), 10 figs, 3 tables, 10 refs

KEY WORDS: Suspension bridges, Seismic response, Torsional response, Frequency domain method

The earthquake-induced torsional response of suspension bridges when subjected to multiple support excitations is analyzed in the frequency domain by random vibration theory. Appropriate rocking and torsional ground motion inputs are defined from finite Fourier transforms of recorded translational motions. A simplified approach based upon wave propagation theory is used. An example is presented in which the torsional response of the Golden Gate Bridge to earthquake ground motions (the 1979 Imperial Valley earthquake) with characteristics significantly different at each support point is investigated. The participation of higher modes in the total response is essential to assess the torsional seismic behavior of such structures. Both the vibrational displacement and vibrational cable tension induced by torsional vibration are very small but the flexural stresses induced by the torsional vibration are relatively large as live loads

85-468

Research in Vibration Analysis of Highway Bridges

H.V.S. GangaRao
West Virginia Univ., P.O. Box 6101, Morgantown, WV 26506

Shock Vib. Dig., 16 (9), pp 17-22 (Sept 1984), 29 refs

KEY WORDS: Bridges, Reviews

This paper reviews literature from 1976-1983 and part of 1984 that deals primarily with the effects of free and forced vibrations of a wide class of highway bridges. Recent research concerned with the effects of earthquakes, impact and dynamic response of concrete and steel girder-slab bridges are summarized.

BUILDINGS

85-469

A Rigid Body Mechanism in Structural Dynamics

R.H. Allen

Ph.D. Thesis, Carnegie-Mellon Univ., 161 pp (1984), DA8414731

KEY WORDS: Buildings

This thesis addresses a rigid body mechanism that has been identified in a precast concrete building system. The building is idealized as an assembly of two-dimensional rigid rectangular bodies subjected to self-imposed kinematic constraints. The linearized SDOF model possesses a piecewise exponential solution, but the free vibration phase plane representation demonstrates that motion is asymptotically stable. Forced response of the linearized SDOF system demonstrates that the system is poorly conditioned.

85-470

Modal Base Forces in Structures Having a Straight-Line Mode of Vibration

G.R. Darbre
P.O. Box 553, CH-8121 Benglen, Switzerland

Earthquake Engrg. Struc. Dynam., 12 (5), pp 703-707 (Sept/Oct 1984), 3 figs, 3 refs

KEY WORDS: Multistory buildings, Modal analysis

The modal base forces in structures with a straight-line mode of vibration are investigated. The orthogonality relationship between the different modes is used to find a relation between the modal base shears and base moments in all but the straight-line mode. This relation states that the contribution of the inertia forces to the modal overturning moments referred to the center of rotation of the straight-line mode is identically null. Contributions of vertical forces and lateral constraints must be accounted for. For the special case in which the straight-line mode is proportional to the height of each story, the center of rotation coincides with the base of the structure. For the case in which the straight-line mode is a uniform displacement, the center of rotation is at infinity, and the contribution of the inertia forces to the modal base shears disappears in all but the straight-line mode.

85-471

Adverse Wind Loads on Low Buildings Due to Buffeting

T. Stathopoulos
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ASCE J. Struc. Engrg., 110 (10), pp 2374-2392 (Oct 1984), 11 figs, 4 tables, 17 refs

KEY WORDS: Buildings, Wind-induced excitation

The paper presents results of a study carried out in a boundary layer wind tunnel to determine the wind loads on low buildings of different geometries in the presence of a tall nearby building at various relative locations. Results show significant adverse effects (wind load amplifications higher than 200%) for particular building configurations. The complexity of the problem indicates that it is difficult to treat these buffeting effects with any degree of generality. Local building officials should require the use of higher design loads after seeking a specialist's advice and possibly performing special wind tunnel tests.

85-472

Free Vibration of Asymmetric Shear Wall-Frame Buildings

T. Balendra, S. Swaddiwudhipong, Ser-Tong Quek, Seng-Lip Lee
McMaster Univ., Hamilton, Ontario, Canada
Earthquake Engrg. Struc. Dynam., 12 (5), pp 629-650 (Sept/Oct 1984), 16 figs, 5 tables, 13 refs

KEY WORDS: Buildings, Natural frequencies, Mode shapes, Galerkin method, Weighted residual technique

The Galerkin method of weighted residuals is used to determine the frequencies and associated mode shapes of asymmetric shear wall-frame structures. The governing equations are formulated using the continuum approach by idealizing the structure as a shear-flexure beam. Varying properties along the height of the building are considered. The effect of translational, rocking and torsional flexibilities of the foundation on the natural frequencies is also investigated. The method utilizes polynomial and transcendental displacement functions and is simple, versatile, and efficient.

85-473

Seismic Analysis of R/C Frame-Wall Structures

J.P. Moehle
Univ. of California, Berkeley, CA
ASCE J. Struc. Engrg., 110 (11), pp 2619-2634 (Nov 1984), 8 figs, 4 tables, 14 refs

KEY WORDS: Multistory buildings, Frames, Walls, Reinforced concrete, Seismic analysis

Inelastic responses of four irregular multistory reinforced concrete frame-wall structures to strong base motions are analyzed using response spectrum methods. The structures have been constructed in small scale; responses during experimental earthquake simulations are reported. Maximum measured responses are compared with responses calculated using concepts of inelastic response spectra and elastic response spectra for a substitute structure. Both procedures produce substantially accurate estimates of maximum responses if initial stiffnesses and ultimate capacities are correctly estimated. Implications of the analyses concerning irregularities in structural systems and concerning code-implied drifts are presented.

85-474

Dynamic Soil-Structure Interactions on Embedded Buildings

J. Kobarg, H. Werkle, O. Henseleit
Bundesministerium des Innern, Bonn, Fed. Rep. Germany
Rept. No. BMI-1983-11, 117 pp (Sept 1983), DE84750749
(In German)

KEY WORDS: Buildings, Soil-structure interaction, Nuclear power plants, Seismic analysis

The dynamic soil-structure interaction on the horizontal seismic excitation is investigated on two embedded auxiliary buildings of a nuclear power plant The structure and the soil are modeled by various analytical and numerical methods. Under the condition of linear viscoelastic theory, the interactive influences between a homogeneous soil layer and a structure are analyzed.

85-475

A Closed Form Earthquake Response Analysis of Multistory Building on Compliant Soil

Y.K. Lin, W.F. Wu
Florida Atlantic University, Boca Raton, FL 33431

J. Struc. Mech., 12 (1), pp 87-110 (1984) 10 figs, 18 refs

KEY WORDS: Multistory buildings, Earthquake response, Seismic response

A transfer matrix formulation is used to analyze structural response of an N-story building to earthquake excitation, including soil compliancy under the footing. The free-field ground acceleration is modeled as an evolutionary random process. Analysis is simplified by assuming that the superstructure is composed of N identically constructed story units. The soil behavior is characterized by a known impedance matrix or a compliance matrix. Closed form solutions obtained for the frequency response functions of the system permit insights into various parameters that affect the response. If the superstructure and the footing remain the same, the effect of soil-foundation interaction is determined by four frequency dependent functions. A numerical example for an eight-story building shows that soil compliancy reduces the levels of both displacement- and force-type response variables, as previously reported by other investigators.

85-476

Interim Summary Report on Tests of 7-Story RC Building

U.S./Japan Joint Technical Coordinating Committee

ASCE J. Struc. Engrg., 110 (10), pp 2393-2411 (Oct 1984) 15 figs, 6 tables, 3 refs

KEY WORDS: Multistory buildings, Earthquake response, Reinforced concrete, Seismic tests

A seven-story full-scale reinforced concrete frame-wall building was tested. The test structure was based on building code requirements in the United States and Japan for earthquake resistance. Reinforcement details were specified to reflect good construction practice in the United States and Japan. The test structure was subjected to static and dynamic loads. A single-degree-of-freedom pseudo-dynamic earthquake response test method was used to investigate the inelastic behavior of the test structure. Four increasing levels of earthquake input were used. Following the fourth pseudo-dynamic test the damaged structure was repaired by epoxy injection and epoxy mortar. Reinforced concrete spandrel walls and various types of nonstructural elements were installed. Three pseudo-dynamic tests were performed. A final static test to concluded the testing.

85-477

Accurate and Simplified Models for Seismic Response Prediction of Steel Frame Structures

Dong-Guen Lee

Ph.D. Thesis, Stanford Univ., 199 pp (1984) DA8412864

KEY WORDS: Multistory buildings, Steel, Seismic response, Earthquake damage

The purposes of this study were to develop analytical models for the prediction of seismic response of multistory steel frame structures and to evaluate the performance of frames. Emphasis is placed on cumulative damage concepts that account for the effect of all inelastic excursions on the seismic performance. The first part of the study is devoted to the development of an accurate analytical model. The second part of the study is devoted to the development of a simplified analytical model in which a multistory steel frame structure is represented by an equivalent SDOF model. The study has shown that the equivalent single-degree-of-freedom system is a simple means for predicting approximately the maximum as well as the cumulative deformation demands in many multistory frame structures subjected to severe earthquakes.

85-478

Dynamic Eccentricity of Structures Subjected to S-H Waves

S.T. Wu, E.V. Leyendecker
National Bureau of Standards, Washington, D.C.
Earthquake Engrg. Struc. Dynam., 12 (5), pp 619-628 (Sept/Oct 1984) 12 figs, 17 refs

KEY WORDS: Buildings, Seismic analysis, Torsional response, Soil-structure interaction

The behavior of coupled lateral-torsional systems subjected to seismic waves is investigated analytically. Numerical results of a few case studies show the contributions of each parameter to the rotational response of the structural systems. Dynamic eccentricity is used to represent the level of rotational response. Accidental eccentricities due to S-H waves are evaluated. Design implications based on this study are given.

85-479
Dynamic Response of Nonlinear Torsionally Coupled Structures
P.K. Syamal
Ph.D. Thesis, Concordia Univ., Canada (1984)

KEY WORDS: Buildings, Seismic response, Torsional response, Ground motion

This thesis is concerned with the nonlinear elastic and inelastic dynamic response of both symmetric and unsymmetric structures. The first stage involves dynamic instability in the torsional response of both single-story symmetric and eccentric buildings. Results for susceptibility to nonlinear torsional coupling in the form of generalized stability diagrams and critical torsional damping are applicable to structures with different distributions of load-resisting elements. Both torsional stability bounds and critical torsional damping are influenced by various system parameters. The second stage is concerned with the inelastic response of single-story monosymmetric structures for sinusoidal ground motion in which coupling arises from eccentricity.

85-480
Continuum Models for Dynamics of Buildings
S.K. Jain
Indian Inst. of Tech., Kanpur 208016, India
ASCE J. Engrg. Mech., 110 (12), pp 1713-1730 (Dec 1984) 5 figs, 16 refs

KEY WORDS: Multistory buildings, Floors, Seismic response, Continuum mechanics

An analytical method was developed for the dynamic analysis of multistory buildings with *significant in-plane floor flexibility*. Expressions are given for the dynamic properties of multistory buildings with end walls (or frames) in the transverse direction. The approach was also applied to the analysis of a multistory building with end walls in the upper stories and several walls in the ground story.

85-481
Conceptual Seismic Design of Frame-Wall Structures
A.E. Aktan, V.V. Bertero
Univ. of California, Berkeley, CA 94720
ASCE J. Struc. Engrg., 110 (11), pp 2778-2797 (Nov 1984) 5 figs, 22 refs

KEY WORDS: Buildings, Frames, Walls, Seismic design

There is a need to emphasize the use of conceptual seismic design principles to overcome the high level of uncertainties involved in present numerical analyses of such systems. The main issues and decisions confronted by the designer in achieving a conceptual seismic design are reviewed. Observed shortcomings of the seismic design building codes used in the U.S. are identified.

85-482
Economics of Seismic Design for New Buildings
J.M. Ferritto
U.S. Dept. of Navy, Port Heuneme, CA 93043
ASCE J. Struc. Engrg., 110 (12), pp 2925-2938 (Dec 1984) 7 figs, 7 tables, 6 refs

KEY WORDS: Buildings, Seismic design

This paper presents data on the cost of increasing the seismic design level of buildings, for new construction, for five concepts of lateral resistance. Damage is shown to be a function of both drift and acceleration. Each design level is analyzed for a series of loadings, and a damage matrix is formulated to relate damage and the applied loading level. An economic analysis evaluates the cost of seismic lateral resistance design levels, the present worth of expected damage, and the probability of site acceleration levels.

85-483
Seismic Performance of Low-Rise Light-Framed Wood Buildings
L.A. Soltis
Forest Products Lab., U.S. Dept. of Agriculture, Univ. of Wisconsin, Madison, WI
Shock Vib. Dig., 16 (11), pp 27-3? (Nov 1984) 53 refs

KEY WORDS: Buildings, Wood, Seismic design, Reviews

This paper reviews literature on the performance of wood structures in earthquakes, examines component and building response, and discusses current design philosophy. Wood structures perform adequately when they are symmetric in plan and elevation and have adequate shear walls. Bad performance occurs when there is a lack of or nonsymmetric arrangement of racking walls.

85-484
R/C Frame Models: Observed Seismic Response
H. Cecen
Englekirk-Hart Consulting Engrs., Inc., 8304 34th Ave., N.E., Seattle, WA 98115
ASCE J. Struc. Engrg., 110 (12), pp 3015-3030 (Dec 1984) 7 figs, 2 tables, 6 refs

KEY WORDS: Multistory buildings, Frames, Reinforced concrete, Seismic tests

Two sets of simulated earthquake tests carried out on 10-story, three-bay reinforced concrete frame models are discussed. A perspective of the structural response during the course of dynamic test runs is provided by the analysis of 10 nondimensional observation parameters. The same base motion will produce basically the same response regardless of differences in previous loading histories, provided all of the previous loadings had intensities less than or equal to that of the loading under consideration.

85-485
R/C Frame Models: SIP Studies on Seismic Response
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ASCE J. Struc. Engrg., 110 (12), pp 3031-3042 (Dec 1984) 7 figs, 2 tables, 6 refs

KEY WORDS: Multistory buildings, Reinforced concrete, System identification, Seismic response

An application of the system identification parameters method to simulated earthquake tests of 10-story three-bay reinforced concrete frame models is presented. A comparative discussion of six case studies points out the need for more sensitivity studies before stable and dependable results can be produced by this method.

85-486
On Dynamics of a Structure with a Frictional Foundation
G. Ahmadi, N. Mostaghel
Clarkson Univ., Potsdam, NY 13676
J. de Mecanique Theor. Appl., 3 (2), pp 271-285 (1984) 13 figs, 8 refs

KEY WORDS: Seismic design, Base isolation, Sliding friction, Computer programs

Dynamics of a rigid structure with a frictional foundation is considered. The basic nonlinear equations of motion are derived and discussed. A computer program for calculation of time histories of motions is developed; examples are given. The special cases of step, sinusoidal, and actual earthquake ground accelerations are treated in detail; the amount of slidings of structure with respect to its foundation are calculated and discussed.

85-487
Seismic Response of Base-Isolated Structures with Vertical-Rocking Coupling
Tso-Chien Pan, J.M. Kelly
Advanced Technology Div., Bechtel National, Inc., P.O. Box 3965, San Francisco, CA 94119
Earthquake Engrg. Struc. Dynam., 12 (5), pp 681-702 (Sept/Oct 1984) 18 figs, 2 tables, 9 refs

KEY WORDS: Buildings, Seismic response, Base isolation

The investigation of the dynamic behavior of a base-isolated building is carried out for both the detuned and the perfectly tuned cases. A simple method results in an approximate solution corresponding to a single-degree-of-freedom system. Numerical results for a base-isolated building subjected to the vertical component of the El Centro earthquake of 1940 were carried out for comparison with analytical results. The proposed modal combination method was superior to the conventional square root of the sum of the squares method in estimating responses. The results also indicated that the approximate single-degree-of-freedom system yields accurate estimations.

TOWERS

85-488
Time Domain Random Wind Response of Cooling Tower
R.K. Kapania, T.Y. Yang
Purdue Univ., West Lafayette, IN
ASCE J. Engrg. Mech., 110 (10), pp 1524-1543 (Oct 1984) 8 figs, 2 tables, 35 refs

KEY WORDS: Cooling towers, Wind-induced excitation, Time-domain method, Monte Carlo method

Random wind response analysis of a cooling tower is performed using the Monte-Carlo simulation approach. Results are presented in the form of time-history response, mean, RMS values, peak values, and gust factors. Frequency domain results are also obtained for the most realistic example to compare with the time-domain results. Favorable agreement is found.

FOUNDATIONS

85-489
Response of a Sliding Structure to Filtered Random Excitation
M.C. Constantinou, I.G. Tadjakhsh
Rensselaer Polytechnic Inst., Troy, NY
J. Struc. Mech., 12 (3), pp 401-418 (1984) 7 figs, 1 table, 22 refs

KEY WORDS: Structure-foundation interaction, Sliding friction, Stochastic processes, Base isolation, Monte Carlo method

The evolutionary stochastic response of a rigid structure resting on a frictional foundation and excited by filtered random excitation is studied analytically and by Monte Carlo simulation. Good correlation is observed between analytical and simulated results.

85-490
Dynamic Analysis of Soil-Pile-Structure Systems
F. Ostadan
Ph.D. Thesis, Univ. of California, Berkeley, 279 pp (1983) DA8413545

KEY WORDS: Soil-structure interaction, Seismic excitation

Two new methods have been developed for dynamic analysis of soil-pile-structure systems. One method, the full method, can be used to analyze foundation(s) with closely spaced piles including batter piles subjected to arbitrary seismic loads or transient loads, such as impact loads. The other method, the simplified method, is a new substructuring method that can be applied to directly loaded foundation(s) with vertical piles. Both methods can handle arbitrary shape flexible foundation cap(s) embedded in a layered viscoelastic half space. The effects of pile-soil-pile and soil-cap interaction can be considered simultaneously. The methods have been implemented in the computer program SASSI. A piloted offshore platform has been analyzed using both the full and the simplified method. The results of this analysis confirms the accuracy, effectiveness, and applicability of the methods to practical problems.

85-491

Dynamic Response of Three-Dimensional Foundations

D.L. Karabalis

Ph.D. Thesis, Univ. of Minnesota, 337 pp (1984) DA8413793

KEY WORDS: Soil-structure interaction, Time domain method, Boundary element technique

The three-dimensional (3-D) dynamic soil-structure interaction phenomenon is studied numerically in the time domain using the Boundary Element Method (BEM). The soil medium, handled by the BEM, is an idealized linear elastic, isotropic, and homogeneous half-space. Surface, rigid or flexible, and embedded rigid foundations are studied under the assumption that they have zero mass. The dynamic disturbances applied on the soil-foundation system are either externally applied loads or obliquely incident waves with a general transient time variation. The most important feature of this work is that it succeeds in formulating the general soil-structure interaction problem for the first time in the time domain with the aid of the time domain BEM. Such a formulation can serve as a basis for extension to nonlinear problems with respect to the foundation and/or the soil medium.

85-492

A Study of Parameters Important to Soil-Structure Interaction in Seismic Analyses of Nuclear Power Plants

T.A. Nelson

Ph.D. Thesis, Univ. of California, 219 pp (1983) DA8407873

KEY WORDS: Soil-structure interaction, Nuclear power plants, Seismic analysis

Techniques for analyzing the effects of soil-structure interaction (SSI) on structures during earthquakes are outlined. Solution techniques are grouped into substructure methods, which break the problem into a series of steps, and direct methods, which analyze the soil-structure model in one step. Case studies are designed to quantify the effects of parameters important to the response of nuclear power plant containment structures.

85-493

Rocking of Rigid Blocks Due to Harmonic Shaking

P.D. Spanos, Aik-Siong Koh

Rice Univ., P.O. Box 1892, Houston, TX 77251

ASCE J. Engrg. Mech., 110 (11), pp 1627-1642 (Nov 1984) 18 figs, 13 refs

KEY WORDS: Structure-foundation interaction, Base excitation, Harmonic excitation, Structural response

The dynamic behavior of rigid-block structures resting on a rigid foundation subjected to horizontal harmonic excitation is examined. For slender structures, the nonlinear equation of motion is approximated by a piecewise linear equation. It is shown that stability diagrams can be beneficial to assessing the toppling potential of a rigid-block structure under a given amplitude-frequency combination of harmonic excitation. Thus, the integration of the equation of motion is circumvented.

85-494

On the Dynamic Stiffness of Circular Ring Footings on an Elastic Stratum

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The Univ. of Texas, Austin, TX 78712

Intl. J. Numer. Anal. Methods Geomech., 8 (5), pp 411-426 (Sept/Oct 1984) 19 figs, 15 refs

KEY WORDS: Footings, Dynamic stiffness

Circular ring footings on an elastic stratum are considered. Static and dynamic stiffnesses are calculated using an efficient numerical technique. The results indicate that static torsional and rocking stiffnesses of a ring footing do not deviate significantly from corresponding stiffnesses of a circular footing for values of the inner-radius-to-outer-radius ratio up to about 0.75. The static horizontal and vertical stiffnesses change considerably only for values of this ratio greater than about 0.60. The change in the stiffness and damping coefficients is small for values of the ratio between 0 and 0.5.

UNDERGROUND STRUCTURES

85-495

Transient Response of Underground Structures to SH-Waves

D.P. Thambiratnam, T. Balendra, C.G. Koh
National Univ. of Singapore, Kent Ridge, Singapore 0511

J. Sound Vib., 95 (2), pp 237-247 (July 22, 1984) 4 figs, 9 refs

KEY WORDS: Underground structures, Transient response, Soil-structure interaction

The transient response of a rigid rectangular underground structure with rounded corners subjected to plane SH-waves is studied. Closed-form solutions for the contributions from the straight and curved segments are superposed to obtain the steady-state response of the structure. Green functions for various angles of incidence of waves are obtained by Fourier synthesis. Results are compared with existing solutions. The Green functions can be used to determine the transient response of the structure when subjected to any other excitation. Results for an excitation in the form of a rectified sine pulse are presented for values of the corner radius r_o.

HARBORS AND DAMS

85-496

Earthquake Analysis of Concrete Gravity Dams Including Reservoir Bottom Absorption and Dam-Water-Foundation Rock Interaction

G. Fenves, A.K. Chopra
Univ. of California, Berkeley, CA

Earthquake Engrg. Struc. Dynam., 12 (5), pp 663-680 (Sept/Oct 1984) 7 figs, 1 table, 13 refs

KEY WORDS: Dams, Concrete, Seismic analysis, Substructuring methods

A substructure method for earthquake analysis of concrete gravity dams, including effects of impounded water and flexible foundation rock, is extended to include effects of alluvium and sediments present at the bottom of actual reservoirs. These effects are modeled approximately by a reservoir bottom that partially absorbs incident hydrodynamic pressure waves and are incorporated into the continuum solution for the hydrodynamic pressure. The dam-water-foundation rock system is idealized as a two-dimensional system and analyzed under the assumption of linear behavior. An example earthquake analysis is presented to demonstrate the results obtained from the analytical procedure.

85-497
Free Vibration Characteristics of Dams on Layered Foundations
Lou Meng-lin
China Civ. Engrg. J., 16 (4), pp 10-22 (1983) CSTA No. 624-83.149

KEY WORDS: Dams, Modal synthesis, Substructuring methods

An improved method, called modal synthesis of substructures, for analyzing the free vibration characteristics of earth dams and concrete gravity dams on layered foundations is developed. It features high analysis accuracy and little computer storage. Two examples are presented.

POWER PLANTS

85-498
Noise in Hydro Power Plants
O. Backteman, P.G. Fallstrom, A. Lundstrom
Backteman Acoustics; Linvagen 24; S-178 00 Ekero, Sweden
Noise Control Engrg. J., 23 (1), pp 5-11 (July/Aug 1984) 3 figs, 4 tables, 4 refs

KEY WORDS: Hydroelectric power plants, Noise generation, Standards

This paper reports on Swedish national noise standards and on a company noise standard developed by the Swedish State Power Board for its power plants. It describes noise measurements in several hydro power plants and lists noise reduction measures and their effects. Results of hearing status measurements are discussed.

85-499
Experience with Nonuniform Damping in the Seismic Analysis of Nuclear Plant Components
B.V. Winkel, L.J. Julyk
Hanford Engrg. Development Lab., Richland, WA
Rept. No. HEDL-SA-2841, CONF-830607-33, 29 pp (Jan 1983) (Pres. at the ASME Pressure Vessel and Piping Conf., Portland, OR, June 19, 1983)
DE84003949

KEY WORDS: Nuclear reactor components, Seismic analysis, Damping effects, Pipes

Various methods for accounting for nonuniform damping in a structural model are reviewed and evaluated. The methods are compared by solving a beam/pipe model subjected to a typical seismic ground motion. A two-degree-of-freedom variable damping parameter study is also presented.

85-500
Flow Induced Vibration Program at Argonne National Laboratory
Argonne National Lab., Rept. No. ANL-CT/VA-2349, 45 pp (Jan 1984)
DE84009233

KEY WORDS: Nuclear reactor components, Heat exchangers, Fluid-induced excitation

The program's objective is to develop and apply new and/or improved methods of analysis and testing for design evaluation of nuclear reactor plant components and heat exchange equipment from the standpoint of flow-induced vibration.

OFF-SHORE STRUCTURES

85-501
Random Dynamic Analysis of Multi-Body Offshore Structures
R.S. Langley
Cranfield Inst. of Tech., Cranfield, Bedford MK40 OAL, UK
Ocean Engrg., 11 (4), pp 381-401 (1984) 14 figs, 23 refs

KEY WORDS: Off-shore structures, Random response, Frequency domain method

A general method for the dynamic analysis of multi-body offshore structures is based on a constraint matrix approach. A method of deriving the constraint matrix for a general structure is used to derive the equations of motion of a whole system from those of its component parts. The response of the system to both first and second order random wave forces is used to calculate the forces and moments in the connecting mechanisms. The structure is assumed to have rigid component parts. A linearized frequency domain method is used. The method is applied to SBS and Yoke-CALM designs of offshore mooring terminals.

85-502

Representation of Double-Peaked Sea Wave Spectra

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Instituto Superior Tecnico, Universidade Tecnica de Lisboa, Portugal
Ocean Engrg., 11 (2), pp 185-207 (1984) 8 figs, 10 tables, 36 refs

KEY WORDS: Off-shore structures, Wave forces

About 1000 measured wave spectra from the North Atlantic and 6000 from the North Sea were analyzed to determine the frequency of occurrence of double-peaked spectra in sea states of different intensity. A four-parameter theoretical formulation was proposed to represent double-peaked spectra and was shown to provide an excellent fit to measured spectra. The average values of spectral parameters describing the two peaks did not show any clear dependence on wave height.

VEHICLE SYSTEMS

GROUND VEHICLES

85-503

Dynamic Performance of a Bulkhead Flat Car

V.K. Garg, Yun Lung Wang, Kuang-Han Chu
Univ. of Maine, Orno, ME 04469
Vehicle Syst. Dynam., 13 (2), pp 73-92 (Aug 1984) 25 figs, 4 tables, 25 refs

KEY WORDS: Railroad cars, Freight cars, Rail-vehicle interaction, Suspension systems (vehicles)

The dynamic performance of a flat car is studied. Performance indices include roll angles, lateral accelerations, center plate loads, side bearing loads, wheel loads and spring deflections. It was found that that most commonly used column load of 4,000 lbs. (17.8 kN) should be used. The spring suspension used in the original car design should be adopted to avoid spring bottoming.

85-504

Influence of Payload on the Dynamic Stresses in Vehicle Structures

S. Horvath, P. Michelberger, D. Szoke
Technical Univ. of Budapest, Hungary
Intl. J. Vehicle Des., 5 (4), pp 407-416 (July 1984) 12 figs, 2 tables, 2 refs

KEY WORDS: Ground vehicles, Cargo, Damping effects, Stiffness effects

The dynamic stresses in passenger-loaded vehicle structures can be determined without increasing the degree of freedom of the vehicle. Tests have shown that a realistic simulation of payload reduces significantly (by 10 to 30%) vehicle stresses (mass forces) in models of elastic structure when compared to passive simulation.

85-505

Effects of Environmental Variables on Truck Noise Emission and Noise Propagation to Test Microphones

J.F. Hemdal, R.N. Baker, P. Saha
The Univ. of Toledo, 2801 W. Bancroft, Toledo, OH 43606
J. Acoust. Soc. Amer., 76 (4), pp 1150-1160 (Oct 1984) 4 figs, 10 tables, 8 refs

KEY WORDS: Trucks, Motor vehicle noise, Environmental effects, Temperature effects

Nine truck-tractor configurations were tested according to SAE Standard J366b -- "Exterior Sound Level for Heavy Trucks and Buses." Tests made according to the standard produce reasonably repeatable results when a vehicle was tested repeatedly at the same test site. Sound emission from truck-tractors was affected by temperature for eight of nine truck configurations. SAE J366b passby test sound levels cannot be practically corrected for environmental effects.

85-506
Dynamic Stability of Heavy Articulated Vehicles
A.G. Nalecz, J. Genin
New Mexico State Univ., Las Cruces, NM
Intl. J. Vehicle Des., 5 (4), pp 417-426 (July 1984) 79 refs

KEY WORDS: Articulated vehicles, Trucks, Pneumatic tires

The review focuses on analytical work and related experiments that pertain to undesirable responses of commercial vehicles. A key to successful simulation of heavy truck behavior is a mathematical model that includes the sensitive elements of the vehicle with sufficient flexibility to enable operational situations to be tested. Pneumatic tires appear to have a significant influence on the dynamic performance of heavy trucks. Nonholonomic constraints have been incorporated in the formulation to supplement knowledge of the dynamical properties of heavy vehicles in emergency maneuvers.

85-507
Bond Graphs for Vehicle Stability Analysis
D.L. Margolis
Univ. of California, Davis, CA 95616
Intl. J. Vehicle Des., 5 (4), pp 427-437 (July 1984) 11 figs, 9 refs

KEY WORDS: Ground vehicles, Stability, Bond graph technique

A bond graph model is constructed, in a contrived manner for a rigid body vehicle. From this basic model, transverse load dynamics, wheel compliance, and frame bending can be easily included. The overall model yields first-order state equations.

SHIPS

85-508
The Dynamical Analysis for a Self-Propelled Sand Scouring Ship
Jin Xianding
Ship Engrg., 6, pp 30-36 (1983) CSTA No. 623.8-83.65

KEY WORDS: Ships, Computer programs, Natural frequencies, Mode shapes

The mode shapes of a sand scouring ship and its structural dynamic response due to the excitation of the propeller have been calculated and analyzed. A two-dimensional model with SAP-5 (Structural Analysis Programme) was used to obtain the first five mode shapes and natural frequencies as well as responses. Mode shapes were also calculated on a beam model by the transfer matrix method.

85-509
A Study on Ship Vibration Using Finite Element Method
Zhong Wan-xie
Appl. Math. Mechanics, 4 (1), pp 41-54 (1983) CSTA No. 531-83.148

KEY WORDS: Ship vibrations, Finite element technique

A two-dimensional finite element model is used to calculate ship vertical vibration. The results of the calculation show that the two-dimensional model is much more efficient than the traditional beam model. Furthermore, the model is relatively simple, cost and time required for the computation is comparatively low and short, and the calculation can be carried out on a medium-sized computer. Therefore, this model is especially appropriate for analyzing the dynamic characteristics of ships at early design stages.

85-510
Double-Precision Evaluation of the Oscillatory Source Potential
J.N. Newman
Massachusetts Inst. of Tech., Cambridge, MA
J. Ship Res., 28 (3), pp 151-154 (Sept 1984) 4 tables, 8 refs

KEY WORDS: Submerged structures, Floating structures, Hydrodynamic excitation

The source potential, or Green function, is the fundamental element of most analytical and numerical techniques for predicting the hydrodynamic forces and pressures acting upon a floating or submerged body. In the present work tables are presented for the source potential and its derivative in the horizontal plane, with double-precision accuracy. These tables are intended primarily for use in verifying numerical computations. The range is sufficient to include all expected situations of practical relevance.

AIRCRAFT

85-511
Simulated Crash Decelerations in a Light Aircraft Cabin
S.R. Sarrailhe
Aeronautical Res. Labs., Melbourne, Australia
Rept. No. ARL/STRUC NOTE-491, 42 pp (Sept 1983) AD-A142 806

KEY WORDS: Crash research (aircraft), Anthropomorphic dummies

A light aircraft cabin containing a seat and anthropometric dummy was subjected to a vertical deceleration to simulate a minor crash. Seats used were typical of those in light aircraft. Tests showed that with most seats a moderate rate of descent (5 m/s) could produce potentially injurious forces in the spine.

85-512
Analytical Model of the Structureborne Interior Noise Induced by a Propeller Wake
M.C. Junger, I.M. Garrelick, R. Martinez, J.E. Cole, III
Cambridge Acoustical Associates, Inc., MA
Rept. No. NASA-CR-172381, 98 pp (May 1984) N84-32119

KEY WORDS: Aircraft noise, Interior noise, Propellers

The structure-borne contribution to the interior noise that is induced by the propeller wake acting on the wing was studied. Analytical models were developed to describe each aspect of this path including the excitation loads, the wing and fuselage structures, and the interior acoustic space. The emphasis is on examining a variety of parameters, and as a result different models were developed to examine specific parameters.

85-513
An Approximate Solution of Aircraft Lateral-Directional Limit Cycle Oscillation Induced by Aerodynamic Hysteresis
Liu Chang
Acta Aeron. et Astron. Sinica, 5 (1), pp 11-17 (1984) CSTA No. 629.1-84.02

KEY WORDS: Aircraft, Hysteretic damping, Aerodynamic loads

Variation of lateral-directional rolling and yawing moments with the yaw angle gives evidence of aerodynamic hysteresis at a high angle of attack. Nonlinear increments of the moment due to aerodynamic hysteresis are linearized by the harmonic linear method. An approximate analytical formula is derived to determine the characteristics of lateral-directional limit cycle oscillation induced by aerodynamic hysteresis. Calculations show that the results are in good agreement with data obtained by a numerical iterating method.

85-514

Compilation and Application of a State-Time Spectrum of Aircraft Ambient Vibration

Gong Qingxiang

Acta Aeron. et Astron. Sinica, 5 (1), pp 24-29 (1984) CSTA No. 629.1-84.04

KEY WORDS: Aircraft

This paper contains a compiling method of the state-time spectrum of aircraft ambient vibration. It is based on statistical data and considers both flight and ground tests.

85-515

Estimation of Aerodynamic Forces and Moments on a Steadily Spinning Airplane

B.N. Pamadi, L.W. Taylor, Jr.

NASA Langley Res. Ctr., Hampton, VA

J. Aircraft, 21 (12), pp 943-954 (Dec 1984) 10 figs, 30 refs

KEY WORDS: Aircraft, Aerodynamic loads

A semi-empirical method is presented for the estimation of aerodynamic forces and moments on a steadily rotating airplane model in a spin tunnel. The approach is based on the application of strip theory and estimation of increments to aerodynamic coefficients because of rotational flow over the stalled airplane. The theory is applied to a light, single-engine general aviation airplane, and results are compared with the corresponding spin tunnel rotary balance test data.

85-516

Vibrational Analysis in Aerodynamics. 1970 - August, 1984 (Citations from the NTIS Data Base)

NTIS, Springfield, VA, 195 pp (Aug 1984) PB84-873348

KEY WORDS: Helicopters, Aircraft, Spacecraft, Bibliographies

This bibliography contains citations concerning excitation and analysis techniques for flight flutter tests. Helicopter generated vibration analysis is emphasized. Variations of flutter are included. Analysis by aeroelastic and dynamic finite element techniques and collocation methods by computer analysis are given.

85-517

Study of Aeroelastic and Structural Dynamic Effects in Multi-Rotor Systems with Application to Hybrid Heavy Lift Vehicles

P.P. Friedmann

Univ. of California, Los Angeles, CA

Rept. No. NASA-CR-173505, 12 pp (Apr 1984) N84-23620

KEY WORDS: Helicopter rotors, Aeroelasticity

An aeroelastic model was used to model a number of aeroelastic problems. The model was used to simulate ground resonance boundaries of a three-bladed hingeless rotor model, including the effect of aerodynamic loads. Theoretical predictions compared well with experimental results.

MISSILES AND SPACECRAFT

85-518

Space Structure Vibration Modes: How Many Exist, Which Ones are Important

P.C. Hughes

Inst. for Aerospace Studies, Toronto Univ., Downsview, Ontario, Canada

Rept. No. UTIAS-TN-252, NASA-CR-173442, 24 pp (Apr 1984) N84-26738

KEY WORDS: Spacecraft, Mode shapes

The author argues that the absurd subspace is not a strength of continuum modeling, but, in fact, a weakness. Partial differential equations are not real structures, only mathematical models. The PDE model and the finite element model are the same model, the latter being a numerical method for dealing with the former. Modes can be selected on dynamical grounds other than frequency alone.

85-519

Evaluation of Efficiently Computed Exact Vibration Characteristics of Space Platforms Assembled from Stayed Columns

J.R. Banerjee, F.W. Williams
Univ. of Wales Inst. of Science and Technology, Cardiff CF1 3EU, Wales

J. Sound Vib., 95 (3), pp 405-414 (Aug 8, 1984) 3 figs, 3 tables, 12 refs

KEY WORDS: Space stations, Computer programs, Natural frequencies, Mode shapes

The exact stiffness matrix method computer program BUNVIS finds the natural frequencies and modes of vibration of rigidly jointed three-dimensional frames containing stayed columns. BUNVIS is applied to a tetrahedral truss designed for space; it has stayed columns as its members and 21 966 degrees of freedom at its nodes. Locating the first 4978 natural frequencies needed 2 h of VAX-11/780 CPU time and 5860 array locations. These natural frequencies appeared in groups for which the associated modes are discussed.

85-520

On Passive Damping Mechanisms in Large Space Structures

H. Ashley
Stanford Univ., Stanford, CA

J. Spacecraft Rockets, 21 (5), pp 448-455 (Sept/Oct 1984) 3 figs, 3 tables, 39 refs

KEY WORDS: Spacecraft, Energy dissipation, Modal damping

This paper focuses on thermal dissipation induced by strain gradients during vibration of monolithic configurations. Past work and the expected magnitudes of this damping are reviewed, along with reasons why it is, to some degree, under the designer's control. Unidirectional metallic composites and other arrangements are examined.

85-521

Evaluation of Missile Aerodynamic Characteristics Using Rapid Prediction Techniques

J. Sun, R.M. Cummings
Hughes Aircraft Co., Canoga Park, CA

J. Spacecraft Rockets, 21 (6), pp 513-553 (Nov/Dec 1984) 17 figs, 28 refs

KEY WORDS: Missiles, Aerodynamic characteristics, Computer programs, Prediction techniques

Nine state-of-the-art rapid prediction codes are surveyed, and the NSWC Aeroprediction and NEAR Missile II codes are selected for detailed evaluation. The abilities and weaknesses of the codes to predict six-component aerodynamics of a diverse range of missile configurations are examined. In general, both codes compared favorably in predicting longitudinal aerodynamics for angles of attack less than 10-15 deg. Both codes possess state-of-the-art and compatible methodology bases. Recommendations are given for an improved aerodynamic prediction code for future missiles.

BIOLOGICAL SYSTEMS

HUMAN

85-522

Community Response to Noise: Is all Noise the Same?

F.L. Hall
McMaster Univ., Hamilton, Ontario, Canada L8S 4K1

J. Acoust. Soc. Amer., 76 (4), pp 1161-1168 (Oct 1984) 3 tables, 51 refs

KEY WORDS: Urban noise, Human response, Averaging techniques

Evidence shows different functions for different noise sources, for different types of one source, and for different studies at the same location. It is sensible simply to use the type of source to categorize differences. An average dose-response curve is thus useful in the face of limited information -- that is, when we cannot specify precisely conditions calling for different functions.

85-523

A Study of Hand Vibration on Chipping and Grinding Operators, Part I: Vibration Acceleration Levels Measured on Pneumatic Tools Used in Chipping and Grinding Operations

D.D. Reynolds, R. Basel, D.E. Wasserman, W. Taylor
Univ. of Nevada, Las Vegas, NV 89154
J. Sound Vib., 95 (4), pp 479-497 (Aug 22, 1984) 18 figs, 3 tables, 14 refs

KEY WORDS: Hand tools, Human hand, Human response, Acceleration measurement

This paper describes acceleration measurements and data analysis of a comprehensive field study of several hundred chipper and grinder workers using pneumatic hand-held tools. Engineering testing of a sampling of these tools indicated that, for a frequency range of 6.3 Hz to 1000 Hz, overall acceleration levels between 2000 m/s^2 and 24,000 m/s^2 were measured on the chisels. Levels between 37 m/s^2 and 350 m/s^2 were measured on the handles of chipping hammers. Hand grinder acceleration levels ranged from 6 m/s^2 to 21 m/s^2.

85-524

A Study of Hand Vibration on Chipping and Grinding Operators, Part II: Four-Degree-of-Freedom Lumped Parameter Model of the Vibration Response of the Human Hand

D.D. Reynolds, R.J. Falkenberg
Univ. of Nevada, Las Vegas, NV 89154
J. Sound Vib., 95 (4), pp 499-514 (Aug 22, 1984) 10 figs, 8 tables, 17 refs

KEY WORDS: Hand tools, Human hand, Human response, Mathematical models

The results of the development of a four-degree-of-freedom, lumped parameter model of the vibration response characteristics of the human hand are presented. Dynamic compliance measurements were made on 75 foundry workers. Curve fitting techniques were employed. Agreement was good between 5 Hz and 1000 Hz in the X- and Y-directions. Agreement was good between 20 Hz and 1000 Hz in the Z-direction.

85-525

A Study of Hand Vibration on Chipping and Grinding Operators, Part III: Power Levels into the Hands of Operators of Pneumatic Tools Used in Chipping and Grinding Operations

D.D. Reynolds, R. Basel, D.E. Wasserman, W. Taylor
Univ. of Nevada, Las Vegas, NV 89154
J. Sound Vib., 95 (4), pp 515-524 (Aug 22, 1984) 5 figs, 3 tables, 15 refs

KEY WORDS: Hand tools, Human hand, Human response

This paper presents a method for calculating power transmitted to the hands of operators who use vibrating hand tools. Results that relate to a comprehensive NIOSH field study of chipper and grinder workers who used pneumatic hand tools are presented. Power in the frequency range of 6.3 Hz to 1000 Hz transmitted to the hand ranged from 1.08×10^3 to 7.23×10^3 J/s for the chisel and from 8.52×10^1 to 1.57×10^2 J/s for the handle of chipping hammers. For pneumatic grinders power transmitted was in the range of 6.58×10^{-3} to 2.35×10^{-3} J/s over the same frequency range.

85-526

Serviceability Limit States: Wind Induced Vibrations

A. Tallin, B. Ellingwood
Polytechnic Inst. of New York, Brooklyn, NY 11201
ASCE J. Struc. Engrg., 110 (10), pp 2424-2437 (Oct 1984) 6 figs, 1 table, 26 refs

KEY WORDS: Buildings, Wind-induced excitation, Human response

This paper summarizes existing data regarding human tolerance of building motion. It describes how a simple checking procedure for this serviceability limit state might be developed using random vibration theory to relate fluctuating wind forces to structural response.

85-527
Some Effects of a Combined Noise and Vibration Environment on a Mental Arithmetic Task
J. Sandover, D.F. Champion
Univ. of Technology, Loughborough LE11 3TU, UK
J. Sound Vib., 95 (2), pp 203-212 (July 22, 1984) 3 figs, 2 tables, 12 refs

KEY WORDS: Human response

Three experiments were conducted with broad band noise and whole-body vibration used as stressors both separately and in combination. The three experiments related to three levels of vibration (0.6, 0.8 and 1.2 m/s^2 rms). The intensity of vibration was set at the specified value. The noise intensity for each subject was set at a value subjectively judged to be of equal intensity to the vibration offered. Significant reductions in performance were observed at low intensities of both noise and vibration.

MECHANICAL COMPONENTS

ABSORBERS AND ISOLATORS

85-528
Study on Effective Application of Soundproofing Materials through Low Noise Prototype Car Development
T. Kitahara, I. Terada, T. Watanabe
Noise and Vibration Lab., Isuzu Motors Ltd., Fujisawa-shi, Japan
Intl. J. Vehicle Des., 5 (4), pp 490-504 (July 1984) 23 figs, 4 refs

KEY WORDS: Absorbers (materials), Acoustic absorption, Motor vehicle noise, Interior noise

An experimental study on an effective interior noise reduction method was executed by constructing a low noise prototype car. Noise insulation materials were applied to a Gemini Diesel as a base car.

85-529
Coupled Response of Base Isolated Structures
Tso-Chien Pan
Ph.D. Thesis, Univ. of California, Berkeley, CA, 124 pp (1983) DA8413549

KEY WORDS: Base isolation, Elastomers, Buildings, Seismic response

An analytical study of the effects of torsional and rocking coupling on the seismic response of base-isolated structures mounted on elastomeric rubber bearings is presented. The results indicate that the effects of coupling induced by an eccentricity and/or the tuning of frequencies are not detrimental to the response of base-isolated structures.

85-530
Twenty Most Often Asked Questions About Shock and Vibration Isolation in Severe Service
C. Gilbert, H. LeKuch
Aeroflex Labs., Inc., Plainview, NY
S/V, Sound Vib., 18 (8), pp 6-8, 10, 12-16 (Aug 1984) 7 figs, 1 table

KEY WORDS: Isolators, Shock isolation, Vibration isolation

The authors discuss briefly what is shock and vibration, what is considered severe service, and the importance of shock and vibration isolation. The bulk of the article covers available isolation hardware.

85-531
An Optimum Design Method for the Dual Dynamic Damper and Its Effectiveness
K. Iwanami, K. Seto
Tokyo Metropolitan Technical College, Sinagawa, Tokyo, Japan
Bull. JSME, 27 (23), pp 1965-1973 (Sept 1984) 18 figs, 3 refs

KEY WORDS: Dynamic absorbers, Optimum design, Damping coefficients

Optimum design procedure for a dual dynamic absorber is described, and optimum values for its tuning and damping parameters are specified in graphs and by formulas for the design. Effectiveness of the dual dynamic absorber in reducing transmissibility at resonance is shown to be considerably greater than that of the conventional dynamic absorber. It is also possible to avoid a decrease of damping performance by the changing of the natural frequency of the main vibration system and damping in absorbers.

85-532
Free Sliding, Constrained, or Fixed...
Indus. Lubric. Trib., 36 (2), pp 52-54 (Mar/-Apr 1984) 11 figs

KEY WORDS: Bearings, Supports, Bridges, Pipelines

Mechanical and composite bearings developed to cushion the movement of bridge structures and pipeline supports due to weather, high loads, or ground settlement are described.

SPRINGS

85-533
Determining the Characteristics of Helical Springs for Application in Suspensions of Railway Vehicles
G. Sauvage
Societe Nationale des Chemins de Fer Francais
Vehicle Syst. Dynam., 13 (1), pp 19-41 (July 1984) 9 figs, 2 refs

KEY WORDS: Helical springs, Railroad trains, Suspension systems (vehicles)

This study concerns theoretical calculation of the characteristics of helical springs used in primary and secondary suspensions of railway vehicles. Static characteristics are determined by an exact method. Dynamic characteristics are determined with the help of an approximate method. Its precision is sufficient to allow a valid evaluation of the dynamic behavior of the vehicles themselves.

85-534
Determining the Characteristics of Helical Springs: A Simplification for Application in Railway Suspensions
G. Sauvage
Societe Nationale des Chemins de Fer Francais
Vehicle Syst. Dynam., 13 (1), pp 43-59 (July 1984), 11 figs, 3 refs

KEY WORDS: Helical springs, Suspension systems (vehicles), Railroad trains

Exact methods of calculation for the characteristics of rectilinear and helical springs can be simplified replacing the helical spring with an equivalent rectilinear model.

TIRES AND WHEELS

85-535
Tire Squeal
T. Senda, M. Nakai, M. Yokoi, Y. Chiba
Ship Res. Inst., Ministry of Transport, Shinkawa 6-38-1, Mitakashi, Tokyo, Japan
Bull. JSME, 27 (23), pp 2016-2023 (Sept 1984), 13 figs, 4 tables, 8 refs

KEY WORDS: Tires, Self-excited vibration

Three kinds of experiments dealing with squeal noises produced by tires during severe cornering are reported. Tire squeal occurs when the sliding velocity of a tire reaches 1.1 - 1.7 m/s. Squeal noise occurs due to the self-excited vibration of tire tread. Its frequency is determined only by the thickness of the vibrating part of the tread and is nearly in inverse proportion to rubber thickness.

BLADES

85-536

Vibration and Flutter of Mistuned Bladed-Disk Assemblies

K.R.V. Kaza, R.E. Kielb

NASA Lewis Res. Ctr., Cleveland, OH

Rept. No. E-2074, NASA-TM-83634, 17 pp (1984), N84-23923

KEY WORDS: Blades, Disks, Tuning, Flutter

An analytical model for investigating vibration and flutter of mistuned bladed disk assemblies is presented. This model accounts for elastic, inertial and aerodynamic coupling between bending and torsional motions of each blade, elastic and inertial couplings between blades and disk, and aerodynamic coupling among blades. Results showed the flexibility of practical disks did not have a significant influence on either tuned or mistuned flutter characteristics. Disk flexibility can influence some system frequencies and forced response.

85-537

Acoustic Measurements of a Full-Scale Rotor with Four Tip Shapes. Volume 1: Text, Appendices A and B

M. Mosher

NASA Ames Res. Ctr., Moffett Field, CA

Rept. No. A-9602-V-1, NASA-TM-85878-V-1, 90 pp (Apr 1984), N84-24327

KEY WORDS: Propeller blades, Helicopters, Noise measurement, Experimental data

The four tip shapes tested were rectangular, tapered, swept, and swept-tapered. Noise data include measurements of the sound pressure level in dB, dBA, and tone-corrected PNdB. Performance measurements are given to aid interpretation of the noise data.

85-538

Hybrid Vibration Mode Analysis of Turbine Blades (Hybride Schwingungsformanalyse an Turbinenschaufeln)

Fortschritt-Berichte VDI-Zt., Reihe 11 No. 59, (1984), 118 pp, 68 figs, 4 tables. Summarized in Forsch. Ing.-Wes., 50 (5), p 147 (May 1984). Avail: VDI-Berlag GmbH, Postfach 1139, 4000 Dusseldorf 1, Germany (In German)

KEY WORDS: Turbine blades, Holographic techniques, Interferometric techniques

Two holographic-interferometric methods for the measurement of vibration modes of turbine blades are described. One is the laser trigger method (OLT method) whose point of reference is the self-generated position of the object and phase vibration. The other is the double exposure method with image derotation for the compensation of rigid body rotation. The OLT method is found to be superior of the two methods.

85-539

Numerical Prediction of Choking Flutter of Axial Compressor Blades

Tang Zhiming and Zhou Sheng

Acta Mechanica Sinica (5), pp 434-443 (1983) CSTA No. 531-83.200

KEY WORDS: Compressor blades, Flutter, Flexural vibrations, Numerical analysis

The onset of choking flutter in bending mode at high subsonic inlet Mach number and low negative incidence is predicted by using a finite difference method developed recently. The effects of geometric and aerodynamic parameters on aeroelastic stability of bending oscillation of a transonic cascade are investigated. Preliminary numerical results show that the existence of shock waves has a significant effect on the aeroelastic stability of transonic cascades.

85-540
Further Investigation of the Coupled Flapping and Torsion Dynamics of Helicopter Rotor Blades
A. Rosen, Z. Beigelman
Technion - Israel Inst. of Tech., Haifa, Israel
Israel J. Tech., 21 (3), pp 109-115 (1983) 9 figs, 1 table, 3 refs

KEY WORDS: Helicopters, Propeller blades, Torsional response

The nature of the coupling between flapping and torsion motions of helicopter rotor blades is investigated. Flapping and torsion motions are usually well separated. A simplified model is used to calculate modes, roots, and time response of the tip path plane. The simplified model is appropriate for mechanics of flight purposes.

85-541
A Three Dimensional Approach to Blade Packet Vibrations
P. Nagarajan, R.S. Alwar
Helicopter Design Bureau, Hindustan Aeronautics Ltd., Bangalore, India
J. Sound Vib., 95 (3), pp 295-303 (Aug 8, 1984) 8 figs, 3 tables, 6 refs

KEY WORDS: Blades, Finite element technique, Natural frequencies, Mode shapes

A three dimensional isoparametric quadratic element with three degrees of freedom (u, v, and w) per node is used for the analysis. The analysis indicates the effects of the presence of the shroud on the natural vibrations of independent blades and the blade packet. Because the blade packets are analyzed as three-dimensional structures, all natural modes can be determined. They include batch modes arising due to the presence of the shroud. Batch modes occur both in bending and torsion.

85-542
Analysis of Turbomachine Blades — A Review
V. Ramamurti, P. Balasubramanian
Indian Inst. of Tech., Madras-600036, India
Shock Vib. Dig., 16 (8), pp 13-28 (Aug 1984) 195 refs

KEY WORDS: Turbomachinery blades, Disks, Reviews

This literature review deals with the static and dynamic analysis of turbine blades and discs. The various formulations and solutions of linear and nonlinear vibrations of blades and discs are summarized. Experimental methods are also discussed.

BEARINGS

85-543
Journal Bearing Response to Excitation and Behavior in the Unstable Region
M. Akkok, C.M.McC. Ettles
The Middle East Technical Univ., Ankara, Turkey
ASLE, Trans., 27 (4), pp 341-351 (Oct 1984) 12 figs, 18 refs

KEY WORDS: Journal bearings, Resonant response

Journal bearings of circular bore, elliptical, and offset-halves designs were subjected to excitation tests over a wide range of frequency. In the stable region of operation, the amplitude of the response correlates reasonably well with solutions of linear theory. Observed natural frequencies were found to correlate well with linear theory solutions for lower range frequency values up to about 0.65. At higher predicted

natural frequencies, the observed resonance was less than the theoretical solutions.

85-544
Stability Analysis of Orthogonally Displaced Bearings
A. Singh, B.K. Gupta
Motilal Nehru Regional Engrg. College, Allahabad, India
Wear, 97 (1), pp 83-92 (Aug 1, 1984) 3 figs, 1 table, 12 refs

KEY WORDS: Journal bearings, Stability

This analysis is a theoretical prediction of stability for a hybrid two-lobe bearing obtained by displacing the lobe centers of an elliptical bearing. An orthogonally displaced bearing is more stable than hitherto known bearings. It is also easier to manufacture. Numerical results are presented for nine combinations of horizontal and vertical displacements of lobes and three L/D ratios.

85-545
Finite Element Analysis of the Stability of Multilayer Elastomeric Bearings
J.C. Simo, J.M. Kelly
Univ. of California, Berkeley, CA
Engrg. Struc., 6 (3), pp 162-174 (July 1984) 10 figs, 18 refs

KEY WORDS: Elastomeric bearings, Stability, Finite element technique

The stability of multilayer elastomeric bearings is considered within the framework of two-dimensional finite elasticity. Simple constitutive equations are considered. A finite element formulation is capable of accounting for very general boundary conditions. Boundary conditions in the form of unilateral constraints explain softening effect that is not produced by material instability. These experimental results provide further justification for the simple constitutive model adopted.

GEARS

85-546
Effects of Rim Thickness on Root Stress and Bending Fatigue Strength of Internal Gear Tooth
S. Oda, K. Miyachika, K. Araki
Tottori Univ., 4-101 Minami, Koyama-cho, Tottori, Japan
Bull. JSME, 27 (230), pp 1759-1764 (Aug 1984) 12 figs, 6 refs

KEY WORDS: Gear teeth, Fatigue life

A root stress analysis by the finite element method, a static loading test, and a bending fatigue test for internal gears of different rim thicknesses were carried out. The validity of the formula for tooth bending strength of internal gears proposed by ISO was examined on the basis of results of the static loading and bending fatigue tests.

FASTENERS

85-547
Fatigue Life of Welded and Bolted Repair Parts
T. Yamasaki, Y. Kawai, Y. Maeda
Kawasaki Steel Corp., Chiba, Japan
ASCE J. Struc. Engrg., 110 (10), pp 2499-2512 (Oct 1984) 11 figs, 1 table, 38 refs

KEY WORDS: Welded joints, Bolted joints, Fatigue tests

Fatigue crack propagation and residual stress measurement tests were conducted using deep-notched wide plate specimens with repaired parts. The main purpose of this study was to evaluate numerically the effects of some weld repair methods and a mechanically patching method with high strength grip bolts on residual fatigue life. The tests proved that the conventional welded repair method with no special treatment reduced fatigue life due to high tensile residual stress induced by welding repairs.

85-548
Fatigue Behavior of Butt Welds with Slag Inclusions
M.D. Bowman, W.H. Munse, W. Will
Purdue Univ., West Lafayette, IN
ASCE J. Struc. Engrg., 110 (12), pp 2825-2842 (Dec 1984) 7 figs, 8 tables, 23 refs

KEY WORDS: Welded joints, Steel, Fatigue tests

The results of an experimental study on the fatigue behavior of transverse welded steel butt joints containing slag inclusion discontinuities are presented. Test results indicate that one-fourth of the total fatigue life was spent in initiating a fatigue crack and 55% of the fatigue life was required for propagation of a crack to the weld surface. A number of fatigue cracks were initiated at small, unintentional discontinuities that could not be detected by radiography. The number of initiation sites and slag inclusion sharpness, size, and position appear to influence fatigue behavior more than slag inclusion length.

85-549
An Investigation of Fatigue and Fretting in a Dovetail Joint
C. Ruiz, P.H.B. Boddington, K.C. Chen
Oxford Univ., Parks Rd., Oxford OX1 3PJ, UK
Exptl. Mech., 24 (3), pp 208-217 (Sept 1984) 11 figs, 4 tables, 7 refs

KEY WORDS: Joints, Fretting corrosion, Corrosion fatigue

Specimens designed to reproduce the state of stress of the dovetail joint between blade and disk in a typical gas-turbine configuration were tested in a 250-kN capacity biaxial fatigue machine. Ti-IMI 829 (disk and blade), Inco 901, and steel FV535 (blades only) were tested. The investigation highlights the importance of fretting at the disk/blade interface. A design parameter that combines fretting damage and peak stress is proposed as a basis for the life assessment of the joints.

85-550
Analytical and Experimental Investigation on the Fatigue Behaviour of Tubular Joints for Offshore Monopod Structures
S.S. Gowda
Ph.D. Thesis, Memorial Univ. of Newfoundland, Canada (1984)

KEY WORDS: Joints, Off-shore structures, Fatigue life

This study is concerned with the analytical and experimental investigation of fatigue behavior of monopod tubular joints in air and cold seawater environments. Seven joints were tested under cyclic loading. The fatigue results of all the joints tested are compared with the relevant U.K. DD 55 Q and AWS-XX S-N curves.

STRUCTURAL COMPONENTS

CABLES

85-551
Wind Induced Motion of Twisted-Paired Conductors
J.S. Townsend
Ph.D. Thesis, Washington State Univ., 284 pp (1984) DA8413910

KEY WORDS: Transmission lines, Wind induced excitation, Cables

Vortex-induced motion and axial rotation of twisted-paired conductors are examined to determine characteristic effects of variable diameter on conductor response. Experimental results from natural vibration of an outdoor test span, forced vibration of an indoor test span, and wind tunnel testing of a scale model form the basis of the study. The aerodynamic mechanism inducing the motion is self-excited, and the minor profile geometry is unstable.

85-552
Dynamical Modelling of Wind-Induced Vibrations of Overhead Lines
D. Schafer
Institut f. Mechanik, TH Darmstadt, Fed. Rep. Germany
Intl. J. Nonlin. Mech., 19 (5), pp 455-467 (1984) 6 figs, 24 refs

KEY WORDS: Transmission lines, Cables, Wind-induced excitation

A dynamical model is presented for the wind-induced vibrations of overhead lines due to Karman vortex shedding. The continuous structure is based on a nonlinear model of a circular rigid cylinder that is oscillating transversally in a flowing fluid. The lock-in effect can be described. Approximate solutions are derived by perturbation theory. The model is able to predict the observed vibration frequency, corresponding vibration mode, and observed vibration amplitude. A new concept of the vortex shedding mechanism on a vibrating cable is presented.

85-553
Towed Cable Behaviour During Ship Turning Manoeuvres
D.A. Chapman
Univ. of Bath, BA2 7AY, UK
Ocean Engrg., 11 (4), pp 327-361 (1984) 13 figs, 6 tables, 11 refs

KEY WORDS: Cables, Towed systems, Ships, Periodic response

Results of dynamic and steady-state cable simulations show that a towed system can behave in two ways on entering a turn. Non-dimensional tables give details of the equilibrium configuration adopted by the cable when the ship maintains a circular course. Graphs are presented from which time constants for the decay of lateral and longitudinal disturbances of 2-D cable profiles can be easily calculated. Derivations of the equations for the steady-state configurations and the time constants are included.

85-554
Internal Resonance in a Plane System of Rods
A. Forys, J. Niziol
Inst. of Physics, Technical Univ. of Cracow, ul. Podchorazych 1, Krakow, Poland
J. Sound Vib., 95 (3), pp 361-374 (Aug 8, 1984) 14 figs, 9 refs

KEY WORDS: Rods, Internal resonance, Damping effects, Inertial forces

The internal resonance has an autoparametric nature. Amplitudes of vibration in the stationary states of internal resonance are investigated. Nonlinear damping and nonlinear inertia have a geometrical nature. Plots of amplitudes vs frequency are presented. The stabilizing effect of masses placed at the articulated joints of the system is shown. The influence of inertia and damping on the character of the curves is considered.

85-555
Group Invariance in Nonlinear Motion of Rods and Strings
R. Seshadri, M.C. Singh
Syncrude Canada, Ltd., Fort McMurray, Alberta, Canada
J. Acoust. Soc. Amer., 76 (4), pp 1169-1174 (Oct 1984) 2 figs, 1 table, 14 refs

KEY WORDS: Rods, Strings, Wave propagation

Problems relating to propagation of waves in rods with nonlinear elastic, elastoplastic, and viscoplastic materials are considered. A classification of linear and nonlinear equations of motion of rods and strings is given by a study of their invariance under inspectional groups: dimensional, translational, and spiral groups of transformations.

85-556
Thermal Effect on Frequencies of Coupled Vibrations of a Rotating Beam of Linearly Varying Semi-Circular Cross-Section
J.S. Tomar, R. Jain
Univ. of Roorkee, Roorkee 247672, U.P., India
J. Sound Vib., 95 (1), pp 1-7 (July 8, 1984) 3 figs, 13 refs

KEY WORDS: Beams, Variable cross section, Turbine blades, Temperature effects

An analysis is presented of the effect of a constant thermal gradient on coupled vibrations of a beam of linearly varying semicircular cross section attached to a rotating disc. A method based on Rayleigh's quotient is used to obtain upper bounds of the frequencies corresponding to the first three modes of vibrations. Frequencies for variable cross section, hub radius, and temperature gradient are obtained.

85-557
Dynamic Stability of Laterally Loaded Buckled Beams
P. Siede
Univ. of Southern California, University Park, Los Angeles, CA 90089-242
ASCE J. Engrg. Mech., 110 (10), pp 1556-1569 (Oct 1984) 6 figs, 9 refs

KEY WORDS: Beams, Impulse response, Stability

The critical uniform lateral pressure of a simply supported beam initially compressed into a buckled state is derived for the cases of static loading, step-loading, and impulse loading. the results are found to be at most about 75% of the corresponding values for shallow sinusoidal arches having the same amplitude. Analysis of the stability of the beam under dynamic loading is similar to that of Hoff and Bruce who used an energy criterion to determine the critical pressures of laterally loaded shallow arches.

85-558
Transient Response of Beam under Initial Stress
D.P. Thambiratnam
National Univ. of Singapore, Kent Ridge, Singapore 0511
ASCE J. Engrg. Mech., 110 (10), pp 1544-1555 (Oct 1984) 3 figs, 2 tables, 15 refs

KEY WORDS: Beams, Transient response, Impulse response, Timoshenko theory

Timoshenko equations, modified to include the presence of initial stress, are used to model the beam. The analysis is based on the concept of a wave as a carrier of discontinuities in the field variable and its derivatives. The numerical results confirm the influence of prestress on the transient velocity, bending moment, and shear force distributions in the beam. Solutions to problems with other boundary conditions can be obtained by using the present results.

85-559
Combination Resonance of Beams under Traveling Follower Load Systems
T. Aida
Faculty of Engrg., Yamaguchi Univ., Ube, Japan
J. Sound Vib., 95 (3), pp 415-422 (Aug 8, 1984) 5 figs, 4 refs

KEY WORDS: Beams, Moving loads, Follower forces, Parametric resonance

The regions of simple parametric and combination resonances of a thin-walled beam under a sequence of equidistant follower loads are estimated using the stability criterion. The effects on the combination resonance of load mass, speed, and frequency of load are examined.

85-560
Stability of Bending-Torsional Vibrations of Curved Thin-Walled Beams
S.A. Ali
King Abdulaziz Univ., Jeddah, Saudi Arabia

J. Sound Vib., 95 (3), pp 341-350 (Aug 8, 1984) 3 figs, 9 refs

KEY WORDS: Curved beams, Flexural vibrations, Torsional vibrations, Stability

The stability of bending-torsional vibrations of a curved thin-walled beam is presented. Principal regions of instability are determined. A parametric study is performed to study the influence of various parameters.

85-561

Vibration of a Rectangular Beam with a Deforming Cross-Section

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Central Electricity Generating Board, South Western Region Scientific Services Dept., Bedminster Down, Bridgwater Rd., Bristol BS13 8AN, UK
J. Sound Vib., 95 (3), pp 397-404 (Aug 8, 1984) 3 figs, 1 table, 6 refs

KEY WORDS: Rectangular beams, Transverse shear deformation effects, Rotatory inertia effects

In this paper Levinson's theory for rectangular beam vibrations is reformulated in energy-minimization terms. The energy expressions are similar to those found for a Timoshenko beam, but are not identical. The two theories are therefore not equivalent, at variance with Levinson's conclusion. Considerable care is needed to deal with a clamped boundary.

85-562

Optimal Design of Beams in Torsion under Periodic Loading

M.H.S. Elwany, A.D.S. Barr
Univ. of Liverpool, Liverpool L69 3BX, UK
J. Sound Vib., 95 (3), pp 375-388 (Aug 8, 1984) 8 figs, 4 tables, 11 refs

KEY WORDS: Beams, Optimum design, Torsional excitations, Harmonic excitation

The analysis covers cases when the excitation frequency is either less than or greater than the fundamental frequency of the beam. The problem is stated in variational form with the introduction of constraints through Lagrange multipliers. The mathematical analysis of the various problems presented results in a system of nonlinear differential equations with associated boundary conditions. The solutions given for some of the cases provide expressions for the design variable and the response.

85-563

Optimal Design of Multiple Vibration Controllers for Elastic Beams

K. Yoshida, T. Shimogo, T. Matsumoto
Keio Univ., 3-14-1 Hiyoshi, Kohoku-ku, Yokohama, 223, Japan
Bull. JSME, 27 (23), pp 1974-1982 (Sept 1984) 16 figs, 2 tables, 16 refs

KEY WORDS: Beams, Vibration control, Optimization, Seismic design

Characteristics of vibration controllers are optimized by the property of optimal control force obtained by optimal control theory. A stationary Gaussian colored noise is used. Straight beam structures of a cantilever and a simply-supported beam, and a bent beam structure with various input directions are examples. Characteristics of the controlled structures, relationships between transmitted force and reduction effect, and the optimal allocation were investigated.

85-564

Flexural Wave Propagation in Beam with Dispersion

K. Nonami, N. Tominari, T. Totani
Chiba Univ., Chiba-city, Japan
Bull. JSME, 27 (23), pp 2008-2015 (Sept 1984) 13 figs, 2 tables, 6 refs

KEY WORDS: Beams, Wave propagation

Wave distortions caused by dispersion to a rectangular wave are calculated by a method based on an approximation by a Fourier series expansion. Distinctive fea-

tures of dispersive waves are shown. Results of the dispersive waves according to the finite element model and the experimental results coincide with the approximated Fourier expansion.

85-565
The Influence of the Bending Axis Curvature Upon Free Vibration of Straight Beams
V. Oravsky
Inst. of Materials and Mechanics of Machines of the Slovak Academy of Sciences, Bratislava, Czechoslovakia
Strojnicky Casopis, 35 (4), pp 473-485 (1984) 7 figs, 6 refs (In Slovak)

KEY WORDS: Beams, Flexural vibration

Free undamped flexural vibrations of beams of constant cross section are investigated. The assumption that bending moment is proportional to bending axis curvature is taken into account. A nonlinear problem is solved. The influence of nonlinearity upon both fundamental frequency and mode of a simply supported beam is analyzed.

CYLINDERS

85-566
Fluid Forces on a Cylinder in Oscillating Flow (1st Report, Sinusoidal Oscillation)
R. Ishiwata, H. Ohashi
Ikutoku Technical Univ., 1030 Shimo-Ogino, Atsugi, Kanagawa, 243-2, Japan
Bull. JSME, 27 (23), pp 1881-1886 (Sept 1984) 14 figs, 10 refs

KEY WORDS: Cylinders, Fluid-induced excitation, Periodic excitation

The present work deals with forces on a circular cylinder in a sinusoidally oscillating flow. Fluid forces were measured and numerically analyzed by FEM. Results show that the measured drag forces are satisfactorily described by Morison's equation. The numerical analysis by FEM proved useful for predictions of fluid forces in this range of amplitudes.

85-567
Wave Forces Acting on a Vertical Circular Cylinder with a Constant Forward Velocity
W. Koterayama
Kyushu Univ., 33 Sakamoto Kasuga, Fukuoka 816, Japan
Ocean Engrg., 11 (4), pp 363-379 (1984) 14 figs, 5 refs

KEY WORDS: Circular cylinders, Wave forces, Submerged structures

Hydrodynamic forces acting on the cylinder forced to surge in a steady flow are measured. Hydrodynamic coefficients were obtained. Wave force coefficients obtained from wave force measurements are compared with hydrodynamic coefficients from surging tests. Experiments show that these coefficients are different from those of the cylinder without a forward velocity.

85-568
Wave Loads on Large Vertical Cylinders: A Design Method
N.J. Shankar, T. Balendra, Chan Eng Soon
National Univ. of Singapore, Kent Ridge, Singapore 0511
Ocean Engrg., 11 (1), pp 65-85 (1984) 18 figs, 2 tables, 17 refs

KEY WORDS: Cylinders, Wave forces, Design techniques

A design method is presented in the form of simple design charts for estimating wave forces and moments on large cylinders of arbitrary sections. The numerical solutions have been checked by comparison with other theoretical solutions and experimental data. Application of the design method to a case study shows good correlation with experimental and other theoretical solutions.

COLUMNS

85-569
Analytical and Experimental Vibration and Buckling Characteristics of a Pretensioned Stayed Column
W.K. Belvin
NASA Langley Res. Ctr., Hampton, VA
J. Spacecraft Rockets, 21 (5), pp 456-462 (Sept/Oct 1984) 15 figs, 1 table, 11 refs

KEY WORDS: Columns, Modal tests, Finite element techniques, Computer programs

Modal vibration tests to determine the lateral vibration modes of a stayed column and static axial compression tests to determine the column's buckling and postbuckling behavior have been performed. Results indicate premature buckling of the column due to vibration-load interaction and nonlinear oscillations due to stay slackening. Guidelines for design of pretensioned structures are presented that consider buckling, postbuckling, and vibration behavior.

FRAMES AND ARCHES

85-570
Nonlinear Dynamic Analysis Using Mode Superposition
M.M. Akkari
Ph.D. Thesis, Univ. of California, Davis, CA, 155 pp (1984) DA8416876

KEY WORDS: Frames, Seismic excitation, Modal superposition method

The use of the mode superposition method in nonlinear dynamic analysis of two-dimensional elasto-plastic framed structures subjected to an artificial earthquake loading is studied. Results are compared to the direct integration solutions. The results of a few sample analyses are presented along with some conclusions and suggestions.

85-571
Evaluation of Seismic Behavior of a Braced Tubular Steel Structure by Pseudodynamic Testing
P.B. Shing, A.S. Javadian-Gilani, S.A. Mahin
Univ. of California, Berkeley, CA 94720
J. Energy Resources Tech., Trans. ASME, 106 (3), pp 319-328 (Sept 1984), 11 figs, 3 tables, 12 refs

KEY WORDS: Frames, Seismic response, Testing techniques

The inelastic seismic behavior of an X-braced, tubular steel frame is studied experimentally by means of pseudodynamic testing. This paper presents a brief outline of the experimental procedure and the results of the tubular frame tests. Correlation of these results with previous experimental studies illustrates the feasibility and accuracy of the new test method.

85-572
Static and Dynamic Modeling and Analysis of Tube Frames
P.C. Chang, D.A. Foutch
Univ. of Maryland, College Park, MD 20742
ASCE J. Struc. Engrg., 110 (12), pp 2955-2975 (Dec 1984), 16 figs, 4 tables, 6 refs

KEY WORDS: Frames, Tubes, Natural frequencies, Mode shapes

The paper presents an approximate method in which the tube structure is represented by a continuum. The model considers the shear-lag effect as well as shear and flexural deformation. The continuous model is represented by a set of first-order differential equations. The deflection, frequencies and mode shapes predicted by the continuous model show excellent comparison to the finite element results.

85-573
Modal Analysis of a Deployable Truss Using the Finite Element Method
D.V. Hutton
Washington State Univ., Pullman, WA

J. Spacecraft Rockets, 21 (5), pp 468-472 (Sept/Oct 1984), 4 figs, 3 tables, 9 refs

KEY WORDS: Trusses, Modal analysis, Finite element technique

To assess the dynamic characteristics of a deployable space truss, a finite element model of the science and applications space platform truss has been formulated. The model incorporates all additional degrees of freedom associated with the pin-jointed members. Comparison of results with structural performance and redesign models of the truss shows that the joints of the deployable truss affect the vibrational modes of the structure significantly only if the truss is relatively short.

MEMBRANES, FILMS, AND WEBS

85-574
A Review of Approximate Methods for Determining the Vibrational Modes of Membranes
J. Mazumdar
The Univ. of Adelaide, Adelaide, South Australia 5001
Shock Vib. Dig., 16 (10), pp 9-15 (Oct 1984), 50 refs

KEY WORDS: Membranes, Approximation methods, Reviews

This review covers only work reported in the literature since 1979. Recent research dealing with free and forced vibrations, nonlinear effects, and other complicating factors is summarized.

85-575
Effects of Air Loading on Timpani Membrane Vibrations
R.S. Christian, R.E. Davis, A. Tubis, C.A. Anderson
Purdue Univ., West Lafayette, IN 47907
J. Acoust. Soc. Amer., 76 (5), pp 1336-1345 (Nov 1984), 2 figs, 7 tables, 17 refs

KEY WORDS: Membranes, Musical instruments, Natural frequencies

Measurements and theoretical calculations of timpani modal frequencies and decay times are made for cases of no kettle enclosure and kettle enclosures of varying volume. The timpani membrane is assumed to be ideal. The kettle is assumed to be a rigid cylinder with volume equivalent to the actual kettle. A Green function method is used for calculating the effects of air loading. The calculated modal frequencies and decay times are generally in good agreement with experimental measurements.

PLATES

85-576
Mode III Stress-Intensity Factors in Cracked Orthotropic Plates — An Analogy with Propagating Cracks in Isotropic Media
P.S. Theocaris, H.G. Georgiadis
The National Technical Univ. of Athens, 5, Heroes of Polytechnion Ave., Zographou, GR-157 73 Athens, Greece
Exptl. Mech., 24 (3), pp 177-183 (Sept 1984), 5 figs, 21 refs

KEY WORDS: Plates, Crack propagation, Orthotropism, Isotropy

The method of reflected caustics was extended to deal with stationary cracks in orthotropic plates. A correspondence between the anisotropic stationary case and the case of a Mode III dynamic crack, traversing an isotropic plate is developed. The dynamic problem of propagating crack in an isotropic medium can be simulated by considering the experimentally easier anisotropic stationary case.

85-577
Pressure Distributions Around an Airfoil Placed in a Periodically Fluctuating Air Flow (1st Report, A Flat Plate Approximation)

H. Yoshiki, N.. Kamikawa, Y. Tsutsui, N. Takama
Inst. of Industrial Science, Univ. of Tokyo, 22-1 Roppongi 7-chome, Minato-ku, Tokyo, Japan
Bull. JSME, 27 (230), pp 1592-1597 (Aug 1984), 7 figs, 9 refs

KEY WORDS: Plates, Airfoils, Fluid-induced excitation, Periodic excitation

This paper describes theoretically and experimentally obtained pressure distributions around an airfoil placed in a periodically fluctuating air flow. It is necessary to consider the distribution of airfoil thicknesses in order to calculate time-averaged values and phase angles with high accuracy.

85-578

Pseudo-Shock in Radial Supersonic Flow with Swirl

R. Yamane, S. Oshima, K. Okada
Tokyo Inst. of Technology, Ookayama 2-12-1, Meguro-ku, Tokyo, Japan
Bull. JSME, 27 (229), pp 1467-1471 (July 1984), 9 figs, 6 refs

KEY WORDS: Plates, Pseudo shock waves, Walls

The length and pressure recovery of the pseudo-shock were smaller than those in a straight channel. Pressure recovery decreased with growth of the swirl. Pressure fluctuation at two different points along the radius was statistically correlated.

85-579

On Vibration of Plates with Varying Stiffener Length

P.S. Nair, M.S. Rao
Structures Section, ISRO Satellite Centre, Bangalore 560 058, India
J. Sound Vib., 95 (1), pp 19-29 (July 8, 1984), 5 figs, 5 tables, 15 refs

KEY WORDS: Plates, Stiffener effects, Natural frequencies, Finite element technique

Fabrication considerations sometimes make it necessary to stop a stiffening member at a short distance from the supporting edge of a panel. The effect of a gap between stiffener tip and supporting edge on the natural frequencies is investigated using a finite element approach.

85-580

Effect of In-Plane Inertia on Buckling of Imperfect Plates with Large Deformations

H. Pasic, G. Herrmann
The Univ. of Sarajevo, 71000 Sarajevo, Yugoslavia
J. Sound Vib., 95 (4), pp 469-478 (Aug 22, 1984), 1 fig, 1 table, 23 refs

KEY WORDS: Rectangular plates, Initial deformation effects, Inertial forces, Dynamic buckling

A regular, consistent perturbation technique is used. Both the equations of motion and the boundary conditions are perturbed to yield a relatively simple procedure. Both pulse and vibration buckling during parametric resonance are analyzed. In the former case, in-plane inertia can be disregarded. In the latter it plays an important role for non-slender plates.

85-581

Free Vibration Analysis of Rectangular Plates with Cutouts Allowing for Transverse Shear Deformation and Rotary Inertia

G. Aksu
Middle East Technical Univ., Gaziantep, Turkey
Earthquake Engrg. Struc. Dynam., 12 (5), pp 709-714 (Sept/Oct 1984) 2 figs, 1 table, 10 refs

KEY WORDS: Rectangular plates, Discontinuity-containing media, Transverse shear deformation effects, Rotatory inertia effects

The energy approach has been applied for the Mindlin theory dynamic analysis of rectangular plates with cutouts. Account is taken of the effects of both transverse shear deformation and rotary inertia. This study concluded that the effect of a cutout becomes more pronounced as the thickness of the plate approaches the size of the cutout.

85-582

On the Determination of Transient Interlaminar Stresses in a Composite Laminate Subject to Impact

R.K. Kunz
Georgia Inst. of Tech., Atlanta, GA 30332
Mech. Res. Comm., 11 (3), pp 227-232 (May/June 1984) 7 refs

KEY WORDS: Plates, Layered materials, Impact excitation

The objective of this work is to set forth a set of approximate equations of motion and a methodology for their solution. The propagation of stress waves in an infinite laminated plate subject to impact loading is studied. Of particular interest are the stress components on interlaminar surfaces as functions of position and time subsequent to impact. By employing the approximate equations of motion derived and the solution described, transient interlaminar stresses due to impact on a general laminate can be obtained.

85-583

Response of Circular Plates to Thermal Impact

Y. Nakajo, K. Hayashi
Sophia Univ., Tokyo, Japan
J. Sound Vib., 95 (2), pp 213-222 (July 22, 1984) 4 figs, 6 refs

KEY WORDS: Circular plates, Temperature effects

Thermally-induced vibrations of simply-supported circular plates are investigated analytically. The solution is composed of two parts; the first is obtained by neglecting the inertia term. The second represents the vibrating component that oscillates about the first, due to the effect of the inertia.

85-584

Dynamic Stress Analysis of a Solid Rotating Disc

S. Amada
Ship Res. Inst., Ministry of Transport, 6-38-1, Shinkawa, Mitaka, Tokyo, Japan
Bull. JSME, 27 (230), pp 1579-1584 (Aug 1984) 11 figs, 1 table, 9 refs

KEY WORDS: Disks

This paper presents an analysis of dynamic stresses in a solid rotating disc subjected to an arbitrarily varying angular speed. The Laplace transforms are used to find a solution. The inversions are performed by using Cauchy's integral and convolution theorems.

85-585

Explicit Green's Function Approach to Forced Vertical Vibrations of Circular Disk on Semi-Infinite Elastic Space

H. Higashihara
Saitama Univ., 338 Urawa, Japan
ASCE J. Engrg. Mech., 110 (10), pp 1510-1523 (Oct 1984) 7 figs, 16 refs

KEY WORDS: Disks, Vertical vibrations, Forced vibrations, Green function

Arbitrary modes of vertical vibrations of a circular disk on an elastic half space is investigated mathematically. The problem is formulated with an integral equation, which describes explicitly the relation between the vertical displacement of the disk and the normal stress of contact. The Green's function of the problem can be reduced to definite integrals of some higher analytic functions over finite intervals. The integral equation accompanied by the new Green's function affords a basis of analysis.

85-586

Vibration Analysis of Composite Annular Plates by an Integral Equation Technique

R.S. Srinivasan, D. Ranganath, V. Thiruvenkatachari
Indian Inst. of Tech., Madras 600 036, India

J. Sound Vib., 95 (2), pp 143-150 (July 22, 1984) 4 figs, 9 refs

KEY WORDS: Annular plates, Layered materials, Natural frequencies

An integral equation technique is extended to vibration analysis of layered annular plates that are fixed at the inner and outer radii. Results are compared with those of other investigators. A parametric study is made of the effect of layer thickness, the layers being made up of two different materials.

85-587

Non-Linear Axisymmetric Transient Analysis of an Orthotropic Thin Circular Plate with an Elastically Restrained Edge

Y. Nath, P.C. Dumir, M.L. Gandhi
Indian Inst. of Tech., New Delhi-110016, India

J. Sound Vib., 95 (1), pp 85-96 (July 8, 1984) 12 figs, 1 table, 6 refs

KEY WORDS: Circular plates, Transient analysis

The dynamic analog of the von Karman governing differential equations in terms of the normal displacement and the stress function are employed. Four types of uniformly distributed transient loadings are considered. Influences of the orthotropic parameter and the elastic rotational and in-plane edge restraint parameters on the large amplitude response are investigated. The effect of a prescribed in-plane displacement on the nonlinear transient response is also studied.

85-588

Free Vibration Analysis of Annular Sector Plates by Holographic Experiments

M. Swaminadham, J. Danielski, O. Mahrenholtz
Univ. of Hartford, West Hartford, CT 06117

J. Sound Vib., 95 (3), pp 333-340 (Aug 8, 1984) 3 figs, 2 tables, 13 refs

KEY WORDS: Annular plates, Natural frequencies, Mode shapes, Holographic techniques

The present analysis consists of finite element discretization of sector plates with varying amounts of annular area to determine eigenvalues and eigenforms. The analytical results are verified by an experimental method. The test sector plates are harmonically excited by piezoelectric crystals at several of their resonant frequencies; the corresponding eigenforms are holographically recorded using a time-averaged holographic interference method.

SHELLS

85-589

Free Vibration of Non-Circular Cylindrical Shells with Variable Circumferential Profile

G. Yamada, T. Irie, Y. Tagawa
Hokkaido Univ., Sapporo, 060 Japan

J. Sound Vib., 95 (1), pp 117-126 (July 8, 1984) 7 figs, 1 table, 16 refs

KEY WORDS: Cylindrical shells, Natural frequencies, Mode shapes

The governing equations of vibration of a noncircular cylindrical shell are written in a matrix differential equation by using the transfer matrix of the shell. The natural frequencies and mode shapes of vibration are calculated numerically in terms of the matrix elements. The method is applied to cylindrical shells of three or four-lobed cross section, and the effects of the length of the shell and the radius at the lobed corners on the vibration are studied.

85-590

Free Vibration of Joined Conical-Cylindrical Shells

T. Irie, G. Yamada, Y. Muramoto
Hokkaido Univ., Sapporo, 060 Japan
J. Sound Vib., 95 (1), pp 31-39 (July 8, 1984) 6 figs, 12 refs

KEY WORDS: Conical shells, Cylindrical shells, Natural frequencies, Mode shapes

The governing equations of vibration of a conical shell are written as a coupled set of first order differential equations by using the transfer matrix of the shell. The entire structure matrix is obtained, and the frequency equation is derived. The method has been applied to a joined truncated conical-cylindrical shell and an annular plate-cylindrical shell system. Natural frequencies and mode shapes of vibration were calculated numerically.

85-591
Admittance-Matched Structures for the Reduction of Noise in Tank Making Operations
M.G. Pandy, L.L. Koss
Monash Univ., Clayton, Victoria 3168, Australia
J. Sound Vib., 95 (2), pp 261-279 (July 22, 1984) 15 figs, 2 tables, 10 refs

KEY WORDS: Cylindrical shells, Tanks (containers), Noise reduction, Mechanical admittance

The approach is twofold: to investigate the effectiveness of roller supports acting simultaneously as vibration absorbers and to assess the viability of composite beam absorbers attached directly to the cylindrical shell. Results indicate that the mean-value theory is an acceptable predictor when cylindrical shells are considered but requires minor modification for the prediction of the average admittance in the case of a transversely vibrating beam composite.

PIPES AND TUBES

85-592
Blowdown Force Analysis of Piping System under LOCA Conditions Using BLOWDOWN Code
N. Miyazaki, T. Akimoto
Japan Atomic Energy Res. Inst., Tokyo, Japan
Rept. No. JAERI-M-82-124, 45 pp (Sept 1982)
DE84700098

KEY WORDS: Pipelines, Computer programs

The BLOWDOWN code was developed for blowdown force analysis of a piping system under LOCA conditions. This is a post-processor of the thermal-hydraulic analysis code RELAP4/MOD6. Numerical examples are presented to show the effectiveness and limitation of the code.

85-593
WIPS (Whip and Impact of Piping Systems) — Computer Code for Whip and Impact Analysis of Piping Systems. Part A. User's Manual
G.H. Powell, J.P. Hollings, D.G. Row, P. Chen
Lawrence Livermore National Lab., CA
Rept. No. UCRL-15597-VOL-1, 325 pp (June 1984) NUREG/CR-3686-V1

KEY WORDS: Computer programs, Pipelines, Whipping phenomena, Impact response

WIPS consists of a series of 16 computational modules, executed under the control of the WIPS-EXEC executive program. Twelve of the modules are used for specification of piping system properties and analysis control information. These modules constitute the WIPS-INPT package and produce an input data file for the WIPS-ANAL structural analysis module. The remaining three modules produce tabular and graphical results from the WIPS-ANAL output.

85-594
WIPS (Whip and Impact of Piping Systems) — Computer Code for Whip and Impact Analysis of Piping Systems. Part B. Theory Manual

G.H. Powell, J.P. Hollings, D.G. Row, P. Chen
Lawrence Livermore National Lab., CA
Rept. No. UCRL-15597-VOL-2, 182 pp (June 1984) NUREG/CR-3686-V2

KEY WORDS: Computer programs, Pipelines, Whipping phenomena, Impact response

WIPS-ANAL is the structural analysis module of the WIPS code. WIPS-ANAL incorporates a sophisticated solution strategy for nonlinear dynamic analysis, and has a library of five structural elements (PIPE, BEAM, UBAR, SHELL AND GAPF). This manual describes the solution strategy, and presents the assumptions and theory for each of the structural elements.

85-595
WIPS (Whip and Impact of Piping Systems) — Computer Code for Whip and Impact Analysis of Piping Systems. Part C. Programmer's Manual
G.H. Powell, J.P. Hollings, D.G. Row, P. Chen
Lawrence Livermore National Lab., CA
Rept. No. UCRL-15597-VOL-3, 84 pp (June 1984) NUREG/CR-3686-V3

KEY WORDS: Computer programs, Pipelines, Whipping phenomena, Impact response

Information is provided on the free form data input package; the data base manager used in WIPS-ANAL; the procedure required to add new element types to WIPS-ANAL and to the WIPS-INPT package; and the file structures in WIPS-INPT. Information is also provided on computer system requirements.

DUCTS

85-596
Vibration of Pseudo-Shock in Straight Duct (1st Report, Fluctuation of Static Pressure)
R. Yamane, E. Kondo, Y. Tomita, N. Sakae
Inst. of Tech., Ookayama 2-12-1, Meguro-Ku, Tokyo, Japan
Bull. JSME, 27 (229), pp 1385-1392 (July 1984) 20 figs, 12 refs

KEY WORDS: Ducts, Pseudo shock waves, Vibration generation, Noise generation

Vibration of a pseudo-shock in a duct often causes noise, vibration, and breakdown of the duct. The wall static pressure fluctuation was measured along the duct and statistically analyzed to study the mechanism of the pseudo-shock vibration. One frequency was the natural frequency of the air column in the divergent passage attached downstream of the duct. Another was the natural frequency of the air column in the duct downstream of the pseudo-shock.

85-597
Vibration of Pseudo-Shock in Straight Duct (2nd Report, Correlation of Static Pressure Fluctuation)
R. Yamane, M. Takahashi, H. Saito
Inst. of Tech., Ookayama 2-12-1, Meguro-Ku, Tokyo, Japan
Bull. JSME, 27 (229), pp 1393-1398 (July 1984) 18 figs, 3 refs

KEY WORDS: Ducts, Pseudo shock waves, Vibration generation, Noise generation

Fluctuations at two points along the duct are simultaneously measured and correlated statistically in the forms of correlation factors and coherences. Thereby, the propagation of the pressure fluctuations is investigated.

85-598
Sound Transmission in Ducts
N. Romilly
Univ. of Leeds, Leeds LS2 9JT, UK
Shock Vib. Dig., 16 (10), pp 3-7 (Oct 1984) 20 refs

KEY WORDS: Ducts, Sound waves, Wave transmission, Reviews

This article describes the analysis of sound propagation in ducts or waveguides. Membrane and thin plate models are summarized, as is the normal mode method. Double panels and the importance of the accuracy of the panel model are covered. Experimental work and directions for future research are discussed.

85-599
Flow-Resonant Sound Interaction in a Duct Containing a Plate, Part I: Semi-Circular Leading Edge
M.C. Welsh, A.N. Stokes, R. Parker
Commonwealth Scientific and Industrial Res. Organization, Melbourne, Australia
J. Sound Vib., 95 (3), pp 305-323 (Aug 8, 1984) 12 figs, 18 refs

KEY WORDS: Ducts, Plates, Fluid induced excitation

The interaction between flow and flow-induced acoustic resonances near rigid plates with semi-circular leading edges located in a hard-walled duct is described. A potential flow model for the plate with a smooth leading edge is developed, and the acoustic power generated by vortices growing and shedding from the trailing edge is calculated. The rate of growth of the vortices is determined. The technique simulates the influence of a sound field on vortex growth.

BUILDING COMPONENTS

85-600
The Influence of Floor Members on the Behavior of Reinforced Concrete Beam-Column Joints Subjected to Severe Cyclic Loading
R.T. Leon Saenz
Ph.D. Thesis, The Univ. of Texas at Austin, 446 pp (1983), DA8414408

KEY WORDS: Joints, Beam-columns, Floors, Cyclic loads

Eight reinforced concrete beam-column joint subassemblages were tested to investigate the influence of floor members on their response under large cyclic load reversals. Framing beam geometry and the presence of a slab can have a significant influence on the behavior of beam-column joints. A design approach, still under development, leads to frames with wide beams with low reinforcement percentages and to flexurally strong columns.

85-601
Direct Generation of Seismic Floor Response Spectra for Classically and Nonclassically Damped Structures
A.M. Sharma
Ph.D. Thesis, Virginia Polytechnic Inst. and State Univ., 345 pp (1983), DA8415970

KEY WORDS: Floors, Seismic response spectra, Damped structures

Several direct approaches based on the method of mode displacement as well as mode acceleration have been developed and proposed for generation of floor spectra for classically and non-classically damped systems. These approaches are being proposed as better alternatives to the mode displacement approaches which are currently used.

DYNAMIC ENVIRONMENT

ACOUSTIC EXCITATION

85-602
Theory of Acoustic Emission from Phase Transformations
J.A. Simmons, H.N.G. Wadley
National Bureau of Standards, Washington, D.C. 20234
J. Res. of NBS, 89 (1), pp 55-64 (Jan/Feb 1984), 2 figs, 16 refs

KEY WORDS: Acoustic emission

A theoretical framework is developed within which it is possible to predict the acoustic emission for a phase transformation in both crystal structure (elastic constants) and shape (density) change. An integral equation is solved by expressing the source in multipolar form and using the Eshelby equivalent inclusion method to estimate the dynamic multipolar coefficients. Expressions for the source of elastic radiation are calculated for small isotropoic spherical and ellipsoidal inclusions embedded in an isotropic matrix. These are used for interpretation of experiments on martensitic transformations in steels and for identifying information that can be deduced about transformation dynamics from measurements of acoustic emission.

85-603
Acoustic Emission: Establishing the Fundamentals
D.G. Eitzen, H.N.G. Wadley
National Bureau of Standards, Washington, D.C. 20234
J. Res. NBS, 89 (1), pp 75-100 (Jan/Feb 1984), 39 figs, 1 table, 47 refs

KEY WORDS: Acoustic emission

This paper summarizes the problems faced by acoustic emission midway through the last decade, reviews the accomplishments of the NBS program and related research programs, and outlines research that will be required.

85-604
On the Uniqueness of Solution for All Wavenumbers in Acoustic Radiation
K. Brod
Univ. of Houston, Housto., TX 77004
J. Acoust. Soc. Amer., 76 (4), pp 1238-1243 (Oct 1984), 20 refs

KEY WORDS: Sound waves, Wave radiation

If the Green's function for Helmholtz's equation can be expanded into a series of orthogonal functions, an infinite set of integral equations at the boundary results. These null-field equations are shown to possess unique solutions for all wavenumbers. These solutions can be used to represent solutions in the exterior domain as algebraic series.

SHOCK EXCITATION

85-605
Acceleration of Sonic Detonation Waves (Accélération des ondes de detonation soniques)
G. Dammame
Commissariat a l'Energie atomique, Centre d'Etudes de Vaujours, B.P. n 7, 93270 Sevran, France
J. de Mecanique Theor. Appl., 3 (2), pp 197-222 (1984), 6 figs, 3 tables, 10 refs (In French)

KEY WORDS: Shock waves, Sound waves

In a perfect adiabatic fluid, the reaction zone of which is vanishingly narrow, a converging detonation wave is accelerated. We derive the equations of the beginning of the motion and show that, if the boundary conditions are weak, the motion depends only on the initial geometry of the explosive.

85-606
The Effects of Vibration Shock Wave and the Hydraulic Characteristics on Tunnel Rock-Plug Blasting at Fengman
Huang Tao
J. Hydraulic Engrg., (11), pp 18-28 (1983), CSTA No. 627-83.103

KEY WORDS: Blast effects, Underwater explosions, Tunnels, Buildings

This paper presents prototype observation data on an underwater rock-plug blasting at the tunnel intake of Fengman reservoir. Characteristics of the blasting seismic waves in both water and air are given. The paper also gives the calculated dynamical response and discusses safety conditions. A simulation method is given.

85-607
Turbine Missile Perforation of Reinforced Concrete
T.A. Walter, A.M. Wolde-Tinsae
McDonnell Douglas Corp., St. Louis, MO
ASCE J. Struc. Engrg., 110 (10), pp 2439-2455 (Oct 1984), 4 figs, 2 tables, 24 refs

KEY WORDS: Penetration, Reinforced concrete, Turbines, Fracture properties

Improved empirical methods for prediction of perforation of reinforced concrete barriers by missiles produced by turbine fracture are developed. A method is given to allow perforation analysis of reinforced concrete barriers with a thin steel plate affixed to the back face.

VIBRATION EXCITATION

85-608
Self-Sustained Oscillations of a Shock Wave Interacting with a Boundary Layer on a Supercritical Airfoil
C.S. Ventres, M.S. Howe
Boston Univ., 110 Cummington St., Boston, MA 02215
J. Sound Vib., 95 (1), pp 97-115 (July 8, 1984), 4 figs, 24 refs

KEY WORDS: Airfoils, Shock waves - boundary layer interaction, Self-excited vibrations

Interaction of the shock with the boundary layer on the airfoil produced displacement thickness fluctuations which convect downstream and generate sound by interaction with the trailing edge. A feedback loop is established. Details are worked out for an idealized mean boundary layer velocity profile.

85-609
A Prediction Theory of Random Level Distribution Based on a Generalized Difference Type of Fokker-Planck Equation and its Application to Environmental Noise and Vibration, I: Theoretical Study
M. Ohta, K. Hatakeyama, H. Yamada
Hiroshima Univ., Higashi-Hiroshima, Japan
J. Sound Vib., 95 (1), pp 65-74 (July 8, 1984), 12 refs

KEY WORDS: Random excitation, Vibration analysis, Noise generation

A general expression is derived from which any signal can be predicted. This general expression is equivalent to the well known Fokker-Planck equation, with continuous time sampling, in the special case of a Markovian process. Explicit algorithms for estimating moment statistics of arbitrary order are derived.

85-610
A Prediction Theory of Random Level Distribution Based on a Generalized Difference Type of Fokker-Planck Equation and its Application to Environmental Noise and Vibration, II: Experimental Study
M. Ohta, K. Hatakeyama, K. Nishimura
Hiroshima Univ., Higashi-Hiroshima, Japan
J. Sound Vib., 95 (1), pp 75-84 (July 8, 1984), 4 figs, 1 table, 7 refs

KEY WORDS: Random excitation, Vibration analysis, Noise generation

Evidence for the validity and effectiveness of the proposed method is obtained by digital simulation and from road traffic noise. All theoretical results show good agreement with experimental results.

MECHANICAL PROPERTIES

DAMPING

85-611
Nonlinear Attitude Stability of a Dual-Spin Spacecraft Containing Spherical Dampers

P.K. Winfree
Air Force Inst. of Tech., Wright-Patterson AFB, OH
Rept. No. AFIT/CI/NR-84-15T, 74 pp (June 1984), AD-A141 307

KEY WORDS: Dampers, Spacecraft

A perturbation formulation and the generalized method of averaging investigate the attitude motion of a symmetric dual-spin spacecraft containing two spherical dampers arbitrarily located on the axisymmetric rotor and platform. Results using the approximate analytical expression for the nutation angle are compared to corresponding numerical solutions. Good agreement is found, even for large nutation angles.

85-612
Inner Damping Identification by Means of Amplitude Dissipative Characteristic, II: Applications
F. Pochyl, H. Netuka
SIGMA Res. Inst., Olomouc, Czechoslovakia
Strojnicky Casopis, 35 (4), pp 449-458 (1984), 5 refs (In Czech)

KEY WORDS: Internal damping, Parameter identification techniques

Practical application of identification of the generalized function of inner damping by means of so-called amplitude Dk characteristic is given for linear cases of triaxial and uniaxial continuum states of stress.

85-613
Analytical and Experimental Studies of the Active Control of Flexible Structures
T. Dehghanyar
Ph.D. Thesis, Univ. of Southern California (1984) (Avail:Micrographics Dept., Doheny Library, USC, Los Angeles, CA)

KEY WORDS: Active damping, Active vibration control

Two simple and efficient methods are presented for on-line control of flexible structures during episodes of strong disturbance. The first technique uses externally generated short duration pulses to disrupt the rhythmic buildup of the oscillatory motion of the system. The second method utilizes a nonlinear auxiliary mass damper with adjustable motion-limiting stops to dissipate the energy induced by arbitrary excitation. The simulated response of several linear and nonlinear systems under a variety of dynamic environments is examined. Experimental studies with mechanical models are conducted.

85-614
Hydraulic Miniature Dampers (Hydraulische Miniaturdampfer)
A. Ruhnke
Feinwerktech. u. Messtech., 6 (92), pp 311-312 (Sept 1984), 7 figs (In German)

KEY WORDS: Hydraulic dampers

Difficulties occurring in the manufacture of very small hydraulic dampers are shown, and means for calculation and construction are proposed. A procedure for the measurement of damping is presented.

85-615
Dual Clearance Squeeze Film Damper
D.P. Fleming
NASA Lewis Res. Ctr., Cleveland, OH
Rept. No. N84-22562/2, NASA-CASE-LEW-13506-1, 13 pp (Apr 5, 1984), US PAT-APPL-6-596 960

KEY WORDS: Squeeze film dampers, Gas turbines

A dual clearance hydrodynamic liquid squeeze-film damper for a gas turbine engine is presented. Under normal operating conditions the device functions as a conventional squeeze-film damper. When an unbalance reaches abusive levels, a second, larger clearance film becomes active, controlling vibration amplitudes until the engine can be safely shut down and repaired.

85-616
Squeeze Film on Compliant Surface under Step Load (1st Report, Circular Flat Thruster)
K. Ikeukchi, H. Mori
Kyoto Univ., Yoshida Hon-machi, Kyoto, 606, Japan
Bull. JSME, 27 (23), pp 2024-2029 (Sept 1984), 16 figs, 13 refs

KEY WORDS: Squeeze film dampers

Squeeze films between a circular thruster and a flat compliant surface under step load are analyzed by solving momentum equation, Reynolds equation, and elastic equation. Results are verified by experiments. The squeeze film maintains a noncontacting condition if the trapped fluid is more than a critical value. Solid contact arises at the edge at less than critical value. The thruster shows a damping oscillation if its mass is large and the viscosity of the fluid is low.

FATIGUE

85-617
Interdependence of Equivalent Steady Stress, Crack Growth and Failure on Sequence and Amplitude of Irregular Loading
R. Beeuwkes, Jr.
Army Materials and Mechanics Res. Ctr., Watertown, MA
Rept. No. AMMRC-TR-84-6, 29 pp (Feb 1984), AD-A142 951

KEY WORDS: Fatigue life, Crack propagation, Failure analysis

Minimum or other life of material limited by cyclic crack growth and crack failures as a function of the different sequences of amplitudes of loading that may occur under random, quasi-random, or controllable loading conditions is shown. The method covers the most commonly used law of crack growth and of crack failure.

85-618
Fatigue/Impact Studies in Laminated Composites
V.S. Avva
North Carolina Agricultural and Technical State Univ., Greensboro, NC
Rept. No. AFWAL-TR-83-3060, 152 pp (May 1983), AD-A142 841

KEY WORDS: Layered materials, Fatigue life

The residual strength of impact-damaged laminates can be predicted using an analytical model. Both the power law and wearout models appear to be useful in predicting the fatigue life of composite laminates. The magnitude of the minimum projectile velocity causing catastrophic failure in the laminates tested was found as a function of applied stress and number of fatigue cycles.

85-619
Modern Fatigue Data for Dimensioning Vehicle Components Made of Ductile and Malleable Cast Irons - Part I
M. Hück, W. Schütz, H. Walter
Automobiltech. Z., 86 (7/8), pp 325-331 (July/Aug 1984), 13 figs, 4 tables, 23 refs (In German)

KEY WORDS: Fatigue life, Iron, Structural members

The utilization of ductile and malleable case irons for vehicle components is due mainly to economic reasons. Another reason is the need for modern lightweight construction Results represent extensive design data for fatigue-loaded components. Ductile cast irons are compared with one another and their properties contrasted to those of wrought steels for similar applications. Part 1 deals with the materials tested and the results of constant amplitude fatigue testing.

ELASTICITY AND PLASTICITY

85-620
Effect of Inertia on Finite Near-Tip Deformation for Fast Mode-III Crack Growth

J.D. Achenbach, N. Nishimura
Northwestern Univ., Evanston, IL
Rept. No. NU-SML-TR-84-2, 31 pp (Feb 1984), AD-A142 947

KEY WORDS: Crack propagation

The combined effects of finite deformation and material inertia have been analyzed for fast crack growth under anti-plane loading conditions. A steady-state dynamic solution has been obtained for the finite strain on the crackline, from the moving crack tip to the moving transition boundary. The principal result is that the dynamic strain remains bounded at the crack tip, apparently due to the effect of material inertia.

85-621
Determination of Viscoelastic Shear Modulus Using Forced Torsional Vibrations
E.B. Magrab
National Bureau of Standards, Gaithersburg, MD 20899
J. Res. NBS, 89 (2), pp 193-207 (Mar/Apr 1984), 8 figs, 3 tables, 7 refs

KEY WORDS: Viscoelastic properties, Testing techniques, Instrumentation, Torsional vibrations

A forced torsional vibration system has been developed to measure the shear storage and loss moduli on right circular cylindrical specimens. Diameter can vary from 2 to 9 cm; length can vary from 2 to 15 cm. The method and apparatus are usable over a frequency range of 80 to 550 Hz and a temperature range of -20 C to 80 C.

WAVE PROPAGATION

85-622
Linear Wave Modes for Dissipative Fluids with Rate Type Constitutive Equations
A.M. Anile, S. Pluchino
Seminario Matematico, Universita di Catania
Meccanica, 19 (2), pp 104-110 (June 1984), 3 figs, 26 refs

KEY WORDS: Harmonic waves, Wave propagation, Fluids

One-dimensional linear plane harmonic waves in dissipative fluids are studied within the framework of extended linear irreversible thermodynamics The results for the acoustic mode are compared with the available experimental data on the dispersion and absorption of sound in monatomic gases.

85-623
Applications of Stress and Strain Polarization Tensors to Mechanical Behaviour of Composite Materials. Part II: Dynamical Behaviour
Y. Chevalier
Institut Superieur des Materiaux et de la Construction Mecanique, 3, rue Fernand-Hainaut, 93407 Saint-Ouen
J. de Mecanique Theor. Appl., 3 (2), pp 223-254 (1984), 8 figs, 4 tables, 60 refs (In French)

KEY WORDS: Composite materials, Wave propagation

The dynamical response of composite materials with elastic, viscoelastic, isotropic, or anisotropic inclusions is studied. Theory is applied to wave propagation in layered materials:a laminate with two elastic isotropic inclusions, a laminate with two viscoelastic isotropic inclusions, and an angle-ply laminate with four elastic transversely isotropic layers. This approach is accurate and shows that wave attenuation is more important in the composite material than in the inclusions.

85-624
Wave Modes in Non-Local Fluiddynamics
A.M. Anile, S. Pluchino

Seminario Matematico, Universita di Catania
J. de Mecanique Theor. Appl., 3 (2), pp 167-179 (1984), 4 figs, 14 refs

KEY WORDS: Wave propagation, Constitutive equations

Small amplitude waves for a non-local dissipative fluid obeying non-local constitutive equations are studied.

EXPERIMENTATION

MEASUREMENT AND ANALYSIS

85-625
Hardware and Software Selection for Experimental Modal Analysis
C.W. de Silva
Carnegie-Mellon Univ., Schenley Park, Pittsburgh, PA 15213
Shock Vib. Dig., 16 (8), pp 3-10 (Aug 1984), 3 figs, 1 table, 4 refs

KEY WORDS: Experimental modal analysis, Computer aided techniques

Determination of transfer functions via FFT analysis and extraction of natural frequencies are determined. Modal damping ratios and mode shapes from transfer function data, and the construction of mass, stiffness, and damping matrices from modal data are considered. Four commercially available modal analysis systems are considered.

85-626
Identification of Natural Frequencies and Damping Ratios of Machine Tool Structures by the Dynamic Data System Approach
K.J. Kim, K.F. Eman, S.M. Su
Univ. of Wisconsin-Madison, 1513 University Ave., Madison, WI 53706
Intl. J. Mach. Tool Des. Res., 24 (3), pp 161-169 (1984), 6 figs, 4 tables, 6 refs

KEY WORDS: Machine tools, Modal analysis, Parameter identification techniques

An alternative to the conventional method is a direct modal parameter identification method based on the dynamic data system approach. Theoretical relationships between the continuous vibratory system and its discrete representation in the form of autoregressive moving average (ARMA) models is discussed. The proposed method is applied to the analysis of experimental data obtained from a drilling machine. A comparative assessment is given between these results and results obtained by the conventional fourier transform based method.

85-627
Dynamic Shakedown by Modal Analysis
C. Polizzotto
Istituto di Scienza delle Costruzioni, Facolta di Ingegneria, Universita di Palermo, Palermo, Italy
Meccanica, 19 (2), pp 133-144 (June 1984), 1 fig, 18 refs

KEY WORDS: Shakedown theorem, Modal analysis

Dynamic shakedown of discrete elastic-perfectly plastic structures under a specified load history is studied using the dynamic characteristics of the structure provided by modal analysis. Statical and kinematical theorems include lower and upper bound theorems for the minimum adaptation time of the structure. A crucial role is played by the appropriate definition of admissible plastic strain cycle.

85-628
Some Direct Parameter Model Identification Methods Applicable for Multiple Input Modal Analysis
J.M. Leuridan
Ph.D. Thesis, Univ. of Cincinnati, 411 pp (1984), DA8413705

KEY WORDS: Modal analysis, Parameter identification technique

Direct parameter model identification methods are designed to identify an experimental modal model by modelling measurement data directly using constitutive differential equations. In applying the developed methods, frequency response functions, impulse response functions, free decay data, or forced response data can be used. Numerous simulated test cases demonstrate the characteristics of the developed direct parameter model identification methods. Applicability to experimental data is demonstrated.

85-629

Dynamic Spectral Analysis of Infrasonic Signal with Hilbert Transform

Song Zhi-yung and Tu Yan

AACS, 8 (6), pp 331-338 (1983), CSTA No.534-83.44

KEY WORDS: Spectrum analysis, Hilbert transforms

After digital filtering of the signal and Hilbert transform the envelope of the signal in all channels is evaluated. A synthetic infrasonic signal is analyzed with two methods and results compared. In the dynamic spectrum with Hilbert transform, higher resolution can be obtained, the main frequency regions of different modes can be separated. Waveforms can be obtained for a few lower modes.

85-630

Combined Experimental/Analytical Modeling Using Component Mode Synthesis

D.R Martinez, T.G. Carne, D.L. Gregory, A.K. Miller

Sandia National Labs., Albuquerque, NM

Rept. No. SAND-83-1889C, CONF-8405-127-2, 13 pp (1984), DE84008293

KEY WORDS: Component mode synthesis, Beams, Natural frequencies, Mode shapes

Using a component mode synthesis (CMS) technique, the experimental model data base for one sybsystem was directly coupled with a finite element model of the other subsystem to create an experimental/analytical model of the total structure. Both the translational and rotational elements of the residual flexibilities and mode shapes at the interface of the experimental subsystem were measured and used in the coupling.

85-631

Evaluation of a Vibration Technique for Detection of Barely-Visible Impact-Damage in Composites

R. Jones, A. Goldman

Aeronautical Res. Labs., Melbourne, Australia

Rept. No. ARL/STRUC-TM-370, 22 pp (Dec 1983), AD-A142 807

KEY WORDS: Fiber composites, Nondestructive testing techniques, Vibration analysis

A vibration analysis technique has been used for nondestructive evaluation of the integrity of fiber composite components with barely-visual impact damage. Descriptions of the method and the associated problems are presented together with results of laboratory tests.

85-632

Hybrid Vibration Analysis of Turbine Blades (Hybride Schwingunsformanalyse an Turbinenschaufel)

Fortschritt-Berichte VDI-Zt., Reihe 11, No. 59 (1984), 118 pp, 68 figs, 4 tables, Summarized in Forsch. Ing.-Wes, 50 (5), p 147 (May 1984). Avail: VDI-Berlag GmbH, Postfach 1139, 4000 Dusseldorf 1, Germany, Price 75,-DM (In German)

KEY WORDS: Vibration measurement, Turbine blades, Holographic techniques, Interferometric techniques

A holographic-interferometric method for the determination of resonant frequencies and mode shapes of rotating turbine blades in a centrifugal force field is described.

85-633

Averaging for Improved Frequency Response Functions

C. Van Karsen, R.J. Allemang

Structural/Kinematics Corp., Troy, MI

S/V, Sound Vib., 18 (8), pp 18-26 (Aug 1984) 19 figs, 17 refs

KEY WORDS: Frequency response function, Averaging techniques

This article discusses averaging and how it applies to frequency response function measurement. Several averaging methods will be presented along with results obtained from actual test situations.

DYNAMIC TESTS

85-634

An Apparatus for the Study of Wear Under Dynamic Loading Conditions

F.C. White, S.T. Noah, C.F. Kettleborough, R.B. Griffin

Texas A & M Univ., College Station, TX 77843

Wear, 97 (1), pp 179-197 (Aug 1, 1984), 14 figs, 3 tables, 26 refs

KEY WORDS: Wear, Instrumentation

The apparatus is primarily an impact wear testing device but can also be used for vibratory and oscillatory wear experimentation. The system utilizes a versatile displacement- and force-controlled device. Features permit testing at elevated frequencies and investigation of the effect of individual parameters on the wear process. Modifications to include lubrication and environmental control, measurement of friction forces and fretting wear capabilities are facilitated. Some initial results are included.

85-635

Multi-Dimensional Coupled Vibrations of Piezoelectric Vibrators II Composite Piezoelectric Vibrators

Ren Shu-chu

Acta Acustica, 8 (5), pp 271-279 (1983), CSTA No. 534-83.37

KEY WORDS: Piezoelectric shakers, Fundamental modes

This paper describes an analysis of the fundamental mode of three-dimensional coupled vibrations of composite piezoelectric vibrator using the apparent elasticity method A satisfactory agreement is obtained between our results and published results calculated using the finite element method. A frequency dispersion formula of longitudinal wave phase velocity in the finite cylinder is given and a comparison is made between it and those in the infinite cylinder. This method can be also used to calculate the resonant frequencies of other composite piezoelectric vibrators.

85-636

Evaluation of the Pseudodynamic Method for Seismic Performance Testing Considering the Effects of Experimental Errors

Pui-Shum B. Shing

Ph.D. Thesis, Univ. of California, Berkeley, 178 pp (1983), DA8413587

KEY WORDS: Seismic tests, Error analysis

This analytical study investigates the effects of experimental errors on pseudodynamic test results. The characteristics of error propagation are identified and numerical methods for predicting and suppressing the error-propagation effects are developed. Certain systematic experimental errors are detrimental to pseudodynamic testing. Two numerical methods are proposed.

DIAGNOSTICS

85-637

A Study of Flaw Identification in Adhesive

Bonds Using a Technique of Impact Modification
V.H. Kenner, G.H. Staab, H.S. Jing
The Ohio State Univ., 155 W. Woodruff Ave., Columbus, OH 43210
Exptl. Mech., 24 (3), pp 243-247 (Sept 1984), 10 figs, 5 refs

KEY WORDS: Failure detection, Plates, Composite structures, Layered materials

A small load transducer is used to obtain force histories arising from the impact of steel spheres and flawed, laminated plates. The modification of the force-time record in the presence of the flaw is used to detect these force histories. Tests are reported for both bonded aluminum and glass-epoxy composite plates.

MONITORING

85-638
Periodic Machinery Monitoring: Do It Right
S. Goldman
Goldman Machinery Dynamics Corp., W. Nyack, NY
Hydrocarbon Processing, 63 (8), pp 51-56 (Aug 1984) 2 figs, 1 table

KEY WORDS: Monitoring techniques

The article describes the basics of machinery monitoring, namely, how to get started, data gathering, diagnostics, and some high-frequency bearing monitoring techniques.

85-639
Parameter Identification and Malfunction Detection in Nuclear Reactor Systems
S. Keyvan
Ph.D. Thesis, Univ. of California, Berkeley, 196 pp (1983) DA8413452

KEY WORDS: Nuclear reactors, Parameter identification technique, Monitoring techniques

Time series data from an operating nuclear reactor power plant are analyzed for parameter identification and development of a surveillance scheme for on-line monitoring of possible malfunctions. A surveillance scheme involves construction of a monitoring control chart using the identified transfer function for a properly selected input variable and the reactor power as the output variable. This method is successfully applied to both boiling water reactor and pressurized water reactor data.

85-640
Acoustic Emission/Flaw Relationship for In-Service Monitoring of Nuclear Pressure Vessels
P.H. Hutton, R.J. Kurtz
Battelle Pacific Northwest Labs., Richland, WA
Rept. No. PNL-5125-VOL-1-2, 44 pp (June 1984) NUREG/CR-3825-V1-V2

KEY WORDS: Monitoring techniques, Nuclear power plants, Acoustic emission, Failure detection

This report describes technical progress on a program to apply acoustic emission for continuous integrity surveillance of nuclear reactor pressure boundaries. Development of an ASTM Standard Practice for continuous AE monitoring of pressure boundaries has been initiated. A NUREG document on results from AE monitoring at Watts Bar, Unit 1 reactor during hot functional testing has been completed.

ANALYSIS AND DESIGN

ANALYTICAL MODELS

85-641
Dynamic Equations of Body Motion Linked Up with Spatial Curve through Mathematical Functions
A. Medvec

Dept. of Applied Mechanics and Elasticity of Mechanical Engrg. Faculty of the Technical Univ., Košice, Czechoslovakia
Strójnicky Časopis, 35 (4), pp 487-498 (1984) 2 figs, 6 refs (In Slovak)

KEY WORDS: Dynamic structural analysis, Robots

Kinematic and dynamic equations of motion of a body R linked through mathematical functions with a spatial curve, defined in a three-dimensional space of a body T, are derived. Practical applications in dynamic calculations of industrial robots are given.

85-642
Effect of the CYBER 205 on Methods for Computing Natural Frequencies of Structures
J. Natvig, G. Nour-Omid, B.N. Parlett
Ctr. for Pure and Applied Mathematics, Univ. of California, Berkeley, CA
Rept. No. PAM-218, 44 pp (Mar 1984)
AD-A142 942

KEY WORDS: Natural frequencies, Eigenvalue problems, Lanczos method, Iteration

This report considers the generalized eigenvalue problem (A - gamma M)x = 0, where A and M are large, sparse, symmetric matrices. The authors adopted the best versions of the subspace iteration method and the simple Lanczos method in order to take advantage of the special vector processor of the CYBER 205.

85-643
Dynamically Determining Force Functions for Non-Linear Oscillators
D.K. Arrowsmith
Westfield College, Univ. of London, London NW3 7ST, UK
Meccanica, 19 (2), pp 98-103 (June 1984) 8 figs, 5 refs

KEY WORDS: Forcing function, Oscillators

Various phase portraits that can arise in the phase plane of autonomous nonlinear oscillators are given. The methods involve normal coordinates and blowing up techniques at the origin. Eight topologically equivalent types of phase portrait can arise. The only types that cannot be completely classified are certain classes of centers and foci. The classification is given in terms of algebraic constraints on the coefficients of the Taylor expansion of the force function.

NUMERICAL METHODS

85-644
Application of Desk Computers in Machine Dynamics. Part 2: Moderate Nonlinear Time-Invariant and Time-Invariant Vibrations Systems
V. Schnauder, N. Eicher
VDI-Z., 126 (14), pp 533-536 (July 1984) 7 figs, 3 refs (In German)

KEY WORDS: Numerical analysis, Machinery vibration, Computer-aided techniques

Special numerical methods of machine dynamics are discussed. Through appropriate analytical preparation of the equations of motion numerical integration can be avoided. Vibration calculations can thus be done on desk computers.

STATISTICAL METHODS

85-645
Extremes of Wave Forces
M. Grigoriu
Cornell Univ., Ithaca, NY 14853
ASCE J. Engrg. Mech., 110 (12), pp 1731-1742 (Dec 1984) 5 figs, 2 tables, 17 refs

KEY WORDS: Statistical analysis, Wave forces, Cylinders, Off-shore structures

Probabilistic descriptors for Morison-type wave forces are based on the actual distribution of these forces and on the hypothesis that wave forces follow Gaussian distributions. Both the mean and the variance of the peak wave force can be underestimated significantly when the Gaussian hypothesis is applied. It is assumed in the analysis that the wave particle velocity process follows a Gaussian distribution.

85-646
Load Combinations and Clustering Effects
S.R. Winterstein, C.A. Cornell
Stanford Univ., Stanford, CA
ASCE J. Struc. Engrg., 110 (11), pp 2690-2708 (Nov 1984) 3 figs, 29 refs

KEY WORDS: Probability density function, Failure analysis

The probability of a failure under individual and combined loading is estimated. Second-order reliability accounts for the tendency of threshold crossings to occur in clusters. Various sources of such clustering are identified; their effects on the failure rate are quantified. Extensions to the cases of dependent loads and fatigue-related failures are examined briefly.

85-647
Techniques for Nonlinear Random Vibration Problems
J.B. Roberts
Univ. of Sussex, Falmer, Brighton, Sussex, UK BN1 9QT
Shock Vib. Dig., 16 (9), pp 3-14 (Sept 1984) 1 fig, 88 refs

KEY WORDS: Stochastic processes, Random vibration, Reviews

This review discusses methods for solving nonlinear stochastic problems in dynamics that have been proposed in papers published during the last three years. Emphasis is placed on the application of these methods in engineering applications.

85-648
A Simplified Method for Detecting Information on Linear Correlation Latent in Random Noise or Vibration Waves
H. Minamihara, M. Nishimura, M. Ohta
Hiroshima Denki Inst. of Tech., Hiroshima, Japan
J. Sound Vib., 95 (3), pp 325-332 (Aug 8, 1984) 3 figs, 7 refs

KEY WORDS: Statistical analysis, Correlation technique, Random response

A practical method for detection of a linear correlation function latent in random noise or vibration waves is based on the conditional probability distribution. A simplified version of this detection method does not require higher order statistical information. The effectiveness of the method is confirmed experimentally by applying it to some actual street noise in Hiroshima City.

PARAMETER IDENTIFICATION

85-649
Parameter and State Identification in Non-Linearizable Uncertain Systems
J.M. Skowronski
Univ. of Queensland, St. Lucia, Queensland 4067, Australia
Intl. J. Nonlin. Mech., 19 (5), pp 421-429 (1984) 6 refs

KEY WORDS: Parameter identification techniques

A dynamical process is modeled by a system of nonlinearizable ordinary differential equations with uncertain but bounded state variables and variable parameters. We propose to extend the Lyapunov design technique of building adaptive (on-line) identifiers developed for linear systems with constant parameters. Conditions are introduced together with suitable Lyapunov functions. The method is illustrated on two examples with wide applicability: a damped Hamiltonian system and the nonlinear oscillator.

85-650
Structural Identification by Extended Kalman Filter
M. Hoshiya, E. Saito
Musashi Inst. of Tech., Tokyo, Japan
ASCE J. Engrg. Mech., 110 (12), pp 1757-1770 (Dec 1984) 8 figs, 5 tables, 7 refs

KEY WORDS: System identification techniques, Seismic response, Kalman filter technique

The extended Kalman filter is applied to system identification problems of seismic structural systems. A weighted global iteration procedure with an objective function is proposed for stable estimation. Identification problems are investigated for multiple degree-of-freedom linear systems, bilinear hysteretic systems, and equivalent linearization of bilinear hysteretic systems. The weighted global iteration procedure can be useful in identification problems.

OPTIMIZATION TECHNIQUES

85-651
Optimal Frequency Response Shaping by Appendant Structures
L. Kitis, W.D. Pilkey, B.P. Wang
Worcester Polytechnic Inst., Worcester, MA
J. Sound Vib., 95 (2), pp 161-175 (July 22, 1984) 7 figs, 24 refs

KEY WORDS: Optimization, Frequency response

Two frequency response optimization methods for vibrating systems are developed by appending absorbers to the original structure. the methods are suitable for discrete models with a large number of degrees of freedom and are used to obtain optimal broadband response. Reanalysis and modal techniques are used in the structural dynamic analysis phase of the design algorithm; optimization is carried out by a feasible directions approach. The optimal design algorithm is illustrated by numerical examples for a 39 DOF helicopter model with discrete conventional absorbers and beam absorbers.

COMPUTER PROGRAMS

85-652
User's Guide: Computer Program for Analysis of Two-Dimensional Beam-Columns with Nonlinear Supports (CBNTBM)
W.P. Dawkins
William P. Dawkins, Stillwater, OK
Rept. No. WES-IR-K-84-5, 79 pp (Mar 1984) AD-A143 170

KEY WORDS: Computer programs, Frames, Beam-columns

This report documents a computer program for analysis of a plane frame structure that is an assemblage of beam-column elements with linear and/or nonlinear spring supports. The report describes the structural system considered and the mathematical model used for analysis; force-displacement relationships for the mathematical model and the computational procedure used for solution. The computer program and example solutions are described.

AUTHOR INDEX

ABSTRACT CATEGORIES

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Reciprocating Machines
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Isolation and Absorption
Electromechanical Systems
Optical Systems
Materials Handling Equipment

STRUCTURAL SYSTEMS

Bridges
Buildings
Towers
Foundations
Underground Structures
Harbors and Dams
Roads and Tracks
Construction Equipment
Pressure Vessels
Power Plants
Off-shore Structures

VEHICLE SYSTEMS

Ground Vehicles
Ships
Aircraft
Missiles and Spacecraft

BIOLOGICAL SYSTEMS

Human
Animal

MECHANICAL COMPONENTS

Absorbers and Isolators
Springs
Tires and Wheels
Blades
Bearings
Belts
Gears
Clutches
Couplings
Fasteners
Linkages
Valves
Seals
Cams

STRUCTURAL COMPONENTS

Strings and Ropes
Cables
Bars and Rods
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Cylinders
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DYNAMIC ENVIRONMENT

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Measurement and Analysis
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Scaling and Modeling
Diagnostics
Balancing
Monitoring

ANALYSIS AND DESIGN

Analogs and Analog Computation
Analytical Methods
Modeling Techniques
Nonlinear Analysis
Numerical Methods
Statistical Methods
Parameter Identification
Mobility/Impedance Methods
Optimization Techniques
Design Techniques
Computer Programs

GENERAL TOPICS

Conference Proceedings
Tutorials and Reviews
Criteria, Standards, and Specifications
Bibliographies
Useful Applications

TECHNICAL NOTES

K.W. Yeow
Variation with Distance of Aircraft Noise Impact Parameters
J. Sound Vib., 95 (1), pp 127-130 (July 8, 1984) 3 figs, 7 refs

R.B. Bhat
Obtaining Natural Frequencies of Elastic Systems by Using an Improved Strain Energy Formulation in the Rayleigh-Ritz Method
J. Sound Vib., 93 (2), pp 314-320 (Mar 22, 1984) 2 tables, 3 refs

A.K. Kohli and B.C. Nakra
Vibration Analysis of Straight and Curved Tubes Conveying Fluid by Means of Straight Beam Finite Elements
J. Sound Vib., 93 (2), pp 307-311 (Mar 22, 1984) 3 figs, 8 refs

K.C. Liu
A General Formula for the Space Correlation Function of the Multiply Scattered Field of Randomly Distributed Scatterers of Arbitrary Shape
J. Sound Vib., 94 (2), pp 307-310 (May 22, 1984) 3 refs

N. Ganesan and M.S. Dhotarad
Non-Linear Free Flexural Vibrations of Plates by Two Approaches
J. Sound Vib., 94 (2), pp 311-312 (May 22, 1984) 4 refs

N. Ganesan and M.S. Dhotarad
Hybrid Method for Analysis of Thermally Stressed Plates
J. Sound Vib., 94 (2), pp 313-316 (May 22, 1984) 2 tables, 7 refs

R.B. Bhat
Steady-State Response of Vibrating Systems to Periodic Pulse Excitation
AIAA J., 22 (9), pp 1340-1344 (Sept 1984) 4 figs, 4 refs

F. Farassat
Solution of the Wave Equation for Open Surfaces Involving a Line Integral Over the Edge
J. Sound Vib., 95 (1), pp 136-141 (July 8, 1984) 1 fig, 1 table, 1 ref

T. Irie, G. Yamada, and K. Tanaka
Natural Frequencies of Folded Plates
J. Sound Vib., 95 (1), pp 131-135 (July 8, 1984) 3 figs, 2 refs

J.R. Banerjee
Flutter Characteristics of High Aspect Ratio Tailless Aircraft
J. Aircraft, 21 (9), pp 733-735 (Sept 1984) 4 figs, 1 table, 7 refs

CALENDAR

APRIL

1-3 2nd International Symposium on Aeroelasticity and Structural Dynamics [Deutsche Gesellschaft f. Luft- und Raumfahrt e.V.] Technical Univ. of Aachen, Germany (Symp. Organizing Secretariate, Deutsche Gesellschaft f. Luft- und Raumfahrt, Godesberger Allee 70, D-5300 Bonn 2, W. Germany)

8-12 Acoustical Society of America, Spring Meeting [ASA] Austin, TX (ASA)

14-18 International Conference on Wear of Materials [ASME] Vancouver, BC, Canada (ASME)

15-17 Institute of Acoustics Spring Conference [IOA] York Univ., UK (IOA, 25 Chambers St., Edinburgh EH1 1HU, UK)

15-17 Structures, Structural Dynamics and Materials Conference [ASME] Orlando, FL (ASME)

15-19 2nd Symposium on Interaction of Non-Nuclear Munitions with Structures [Tyndall AFB, FL; Eglin AFB, FL; Kirtland AFB, NM] Panama City Beach, FL (Ms. L.C. Clouston, Registrar, P.O. Box 1918, Eglin AFB, FL 32542 - (904) 882-5614)

22-24 American Power Conference [ASME] Chicago, IL (ASME)

22-26 International Symposium on Acoustical Imaging, The Hague, The Netherlands (J. Ridder, P.O. Box 5046, 2600 GA Delft, The Netherlands)

29-3 31st Annual Technical Meeting and Equipment Exposition [IES] Las Vegas, NV (IES)

MAY

6-8 4th International Symposium on Hand-Arm Vibration [Finnish Inst. of Occupational Health] Helsinki, Finland (I. Pyykko, Inst. of Occupational Health, Laajaniityntie 1, 01620, Vantaa 62, Finland)

6-9 American Society of Lubrication Engineers, 40th Annual Meeting [ASLE] Las Vegas, NV (ASLE)

22-24 Machinery Vibration Monitoring and Analysis Meeting [Vibration Institute] New Orleans, LA (Dr. Ronald L. Eshleman, Director, The Vibration Institute, 101 W. 55th St., Suite 206, Clarendon Hills, IL 60514 - (312) 654-2254)

JUNE

3-5 NOISE-CON 85 [Inst. Noise Control Engrg./Ohio State Univ.] Columbus, OH (NOISE-CON 85, Dept. of Mech. Engrg., Ohio State Univ., 206 W. 18th Ave., Columbus, OH 43210 - (614) 422-1910)

19-21 American Control Conference [ASME] Boston, MA (ASME)

24-26 2nd National Conference and Workshop on Tailoring Environmental Standards to Control Contract Requirements [IES] Leesburg, VA (IES)

24-26 Mechanics Conference [ASME/ASCE] Albuquerque, NM (ASME/ASCE)

JULY

2-4 Ultrasonics International '85, Kings College, London (Z. Novak, Ultrasonics, P.O. Box 63, Westbury House, Bury St., Guildford, Surrey GU2 5BH, England)

11-13 International Compressor Engineering Conference, Lafayette, IN (Purdue Univ., W. Lafayette, IN - (317) 494-2132)

AUGUST

4-8 International Computers in Engineering Conference and Exhibition [ASME] Boston, MA (ASME)

5-10 SAE West Coast International Meeting [SAE] Portland, OR (SAE)

SEPTEMBER

2-7 International Gas Turbine Symposium and Exposition [Gas Turbine Div., ASME; Chinese Natl. Aero-Technology Import and Export Corp.; Chinese Soc. of Aeronautics and Astronautics] Beijing, People's Rep. China (Intl. Gas Turbine Ctr., 4250 Perimeter Park South, Suite 108, Atlanta, GA 30341 - (404) 451-1905)

9-11 19th Midwestern Mechanics Conference [Ohio State Univ.] Columbus, OH (Dept. of Engrg. Mech., Ohio State Univ., 155 W. Woodruff Ave., Columbus, OH 43210 - (614) 422-2731)

10-13 Design Automation Conference [ASME] Cincinnati, OH (ASME)

10-13 Failure Prevention and Reliability Conference [ASME] Cincinnati, OH (ASME)

10-13 Vibrations Conference [ASME] Cincinnati, OH (ASME)

16-20 DIAGNOSTICS - 85 [Technical Univ. Poznan / Polish Academy Sciences] Leszno, Poland (Diagnostics -85, Prof. C. Cempel, Tech. Univ. Poznan, Piotrowo 3, P.O. Box 5, 60-695 Poznan, Poland)

18-20 INTER-NOISE '85 [Intl. Inst. Noise Control Engrg.] Munich, Fed. Rep. Germany (E. Zwicker, Institut f. Elektroakustik, TU Munchen, Arcisstr. 21, 8000 Munchen 2, Fed. Rep. Germany)

OCTOBER

6-8 Diesel and Gas Engine Power Technical Conference [ASME] Grove City, PA (ASME)

8-10 Lubrication Conference [ASLE/-ASME] Atlanta, GA (ASLE/ASME)

8-11 Stapp Car Crash Conference [SAE] Arlington, VA (SAE)

14-17 Aerospace Congress and Exposition [SAE] Los Angeles, CA (SAE)

20-24 Power Generation Conference [ASME] Milwaukee, WI (ASME)

22-24 14th Turbomachinery Symposium [Turbomachinery Labs.] Houston, TX (Dara Childs, Turbomachinery Labs., Dept. of Mech. Engrg., Texas A&M Univ., College Station, TX 77843)

22-24 56th Shock and Vibration Symposium [Shock and Vibration Information Ctr., Washington, D.C.] Monterey, CA (Dr. J. Gordan Showalter, Acting Director, SVIC, Naval Res. Lab., Code 5804, Washington, D.C. 20375-5000 - (202) 767-2220)

NOVEMBER

4-8 Acoustical Society of America, Fall Meeting [ASA] Nashville, TN (ASA)

11-14 Truck and Bus Meeting and Exposition [SAE] South Bend, IN (SAE)

17-22 American Society of Mechanical Engineers, Winter Annual Meeting [ASME] Miami Beach, FL (ASME)

DECEMBER

11-13 Western Design Engineering Show [ASME] Anaheim, CA (ASME)

CALENDAR ACRONYM DEFINITIONS AND ADDRESSES OF SOCIETY HEADQUARTERS

AHS American Helicopter Society
1325 18 St. N.W.
Washington, D.C. 20036

AIAA American Institute of Aeronautics and Astronautics
1633 Broadway
New York, NY 10019

ASA Acoustical Society of America
335 E. 45th St.
New York, NY 10017

ASCE American Society of Civil Engineers
United Engineering Center
345 E. 47th St.
New York, NY 10017

ASLE American Society of Lubrication Engineers
838 Busse Highway
Park Ridge, IL 60068

ASME American Society of Mechanical Engineers
United Engineering Center
345 E. 47th St.
New York, NY 10017

ASTM American Society for Testing and Materials
1916 Race St.
Philadelphia, PA 19103

ICF International Congress on Fracture
Tohoku University
Sendai, Japan

IEEE Institute of Electrical and Electronics Engineers
United Engineering Center
345 E. 47th St.
New York, NY 10017

IES Institute of Environmental Sciences
940 E. Northwest Highway
Mt. Prospect, IL 60056

IMechE Institution of Mechanical Engineers
1 Birdcage Walk, Westminster
London SW1, UK

IFToMM International Federation for Theory of Machines and Mechanisms
U.S. Council for TMM
c/o Univ. Mass., Dept. ME
Amherst, MA 01002

INCE Institute of Noise Control Engineering
P.O. Box 3206, Arlington Branch
Poughkeepsie, NY 12603

ISA Instrument Society of America
67 Alexander Dr.
Research Triangle Pk., NC 27709

SAE Society of Automotive Engineers
400 Commonwealth Dr.
Warrendale, PA 15096

SEE Society of Environmental Engineers
Owles Hall, Buntingford, Hertz.
SG9 9PL, England

SESA Society for Experimental Mechanics (formerly Society for Experimental Stress Analysis)
14 Fairfield Dr.
Brookfield Center, CT 06805

SNAME Society of Naval Architects and Marine Engineers
74 Trinity Pl.
New York, NY 10006

SPE Society of Petroleum Engineers
6200 N. Central Expressway
Dallas, TX 75206

SVIC Shock and Vibration Information Center
Naval Research Laboratory
Code 5804
Washington, D.C. 20375-5000

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